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MAIN FILE

SELECTED MILITARY INFORMATION ON EASTERN EUROPE (11)

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FOREWORD

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SELECTED MILITARY INFORMATION ON EASTERN EUROPE (11)

INTRODUCTION

This is a series publication containing translations of items of military interest from various publications of the Eastern European countries. This report contains translations on the subjects listed in the table of contents, arranged alphabetically by country.

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POLAND

PULLING A FIGHTER PLANE OUT OF A TAILSPIN

[Following is the translation of an article by Pulkownik Pilot W. Hermaszeaski in Wojskowy Przeglad Lotniczy (Military Aviation Review), Vol XII, Warsaw, Dec 60.]

We remember that only 10 years ago air force fighter planes were equipped with a conventional engine; executing a tailspin was an everyday occurrence. These planes easily went into a tailspin, but taking them out of it was no problem at all. The tailspin was executed for educational purposes in practically every flight into the upper altitudes, not only with the instructor but even on the first solo flight.

However, with the introduction of the jet planes such tailspins became less frequent, then were given up. It became evident that the jet plane does not lend itself well to tailspins and, even worse, does not easily come out of them. Much altitude is lost by doing a tailspin; a slight deviation from the established method of bringing a plane out of a tailspin means a delay or even impossibility of coming out of it. This is why tailspins on the jet planes are a major problem.

Why is there such a big difference between the conventional engine and jet powered fighters in the execution of a tailspin? Why does the latter not like to go into it and is peevish going out? Can speed be the reason for the difference? Certainly not.

We know that to increase the maximum speed of the jet plane, designers adopted wings slanted like an arrow. The aero-dynamic propensities of slanted and straight wings are different. The slanted wing does not show tendencies to self-turning during dipping. The reason for this appears to be an air-stream flow from under to over the wing (along the brim). There is the possibility of a partial coefficient equalization of carrying force "Cy" along the wing's whole length. (Fig 1) [Figures are all appended at end of translation].

In addition, many modifications have been introduced in construction which, among other things, reduce the tendencies of a plane's going into a tailspin: aerodynamic combs, increased aileron surfact, etc. On the other hand, the angle of a tail rudder and its construction reduces the effectiveness of direction control and in addition causes a "shadowing" of it by means of the plane's hull and its horizontal stabilizer at the pass-critical press angle; this makes it more difficult to bring plane out of a tailspin.

Thus the characteristics of the new construction and lines of a modern jet fighter are in the angle of plane's wings and tail steering gear; this makes a big difference in the execution of the tailspin.

Knowing these facts better, we will understand when and why a jet plane is going into a tailspin and how it should be taken out of it.

Reason for Self-Entrance into a Tailspin

We know that in a modern fighter, with the smooth pulling of the stick toward the pilot and a neutral position of the vertical stabilizer, the plane does not enter into a tailspin. But with a sufficient reduction of the speed, the plane enters into a spiral or a barrel. It is necessary to remove the pressure of the stick against the pilot to stop a plane's spin and return to normal flight. But with the neutral placement of the vertical steering pedals and pulling the stick vigorously toward the pilot, the plane will shudder and fall off into a left tailspin.

Pressing the stick toward you and reducing flight speed and using your left foot to angle the vertical stabilizer relatively slightly against right resistance, the plane will go into a tailspin corresponding to the position of the control mechanism.

We wonder what causes a plane to go into a tailspin. Why is it necessary to bring the stick energetically toward you so the plane will go into a left not a right tailspin?

The main factor in bringing the plane on a critical angle into a tailspin is a slide acting on the sudden breakoff of the air stream from the wing left behind. (Fig 2) It is the beginning of the autogyration that is a tailspin. In an established left tailspin the plane slides on the right wing and in a right tailspin on the left. We can say that in an established tailspin, jet-propelled planes always execute a slide in the outside direction.

Self-turning by the slanted-wing plane is possible with a slide in the outside direction only. Without the slide, there will be no self-turning. An outside slide adds to the autogyration: the bigger the angle, the more speed of the autogyration angle. On the other hand, an inside slide brakes the self-turning and even changes its direction.

So if during the flight on the critical angles the pilot turns, using the left foot for the vertical stabilizer and turning it to the left, then a slide on the right wing will be executed. Because of the right-wing slide the left wing is left behind, causing a tear-off of the air stream; this causes a sudden decline in the aerodynamic expediency in that wing. There is a sudden drop in the coefficient of the carrying force "Cy" and an increase in the coefficient of the resisting force "Cx". That wing, under influence of the force acting as a brake, drops down and the plane starts to turn, entering into a left tailspin.

The intensity of the aerodynamic decline and the tear-off of the air stream on the left wing depends in that instance on the vertical stabilizer being in the position to the left and upon its angle. The more the steering gear is to the left, the bigger angle of the slide will be. On the other hand, if the vertical stabilizer is placed smoothly into position against the resistance or vigorously to the right(but not against the resistance,) the plane will enter into an inadequate tailspin.

To enter the plane into a right tailspin, we must, after smoothly placing the stick against the pilot and reducing the speed, energetically place the vertical stabilizer against resistance into the position to the right. Entering the plane into a right tailspin is much different than

bringing it into a left. If the plane should drop into a tailspin accidentally, it will be into a left one. This distinct tendency of going into a left tailspin, is caused by the gyroscopical momentum of the engine, which has a very important influence on the plane's slide. Placing the stick toward the pilot and bringing the forward part of the plane upward, due to the gyroscopic momentum of the engine the plane will turn left on the right wing because of the tendency toward going into a left tailspin. (Fig 3) In the same manner, by placing the vertical stabilizer in a neutral position and with an energetic pull on the stick toward you, the gyroscopic momentum will bring the plane into a left tailspin.

Gyroscopic momentum puts the plane into the slide by lifting or lowering the forward part of the plane, causing a left or right slide.

Thus, pulling the stick toward you causes a lift of the forward part of the plane and the beginning of a right slide favorable for the plane to enter into a left tailspin and opposing entrance into the right. On the other hand, letting the stick forward and lowering the forward part of the plane places it in a left slide, which in turn makes it easy for the plane to enter into a left tailspin and oppose entrance into the right.

We see that the entrance of the modern plane into tailspin depends on the slide, and the kind of tailspin on the difference of the slide. The difference in the slide depends on many factors; two of them are the engine's gyroscopic and aerodynamic moments. That is why the kind and regime of the tailspin might vary.

Knowing all the facts, we arrive at the conclusion that jet fighter planes seldom enter into a tailspin; this is a grave mistake in piloting. Such mistakes depend upon placing the stick too energetically against the pilot and a lack of coordination, which results in the slide during the flight with a reduced speed and great pressing angles. This can take place especially during an upward drag and an upper positioning of the vertical figures in an air battle.

Pulling a Plane Out of a Tailspin

Pulling a fighter plane out of a tailspin is the same in all instances. It does not matter under what conditions the plane enters a tailspin; the aerodynamic factors causing a tailspin are the same. Only their character changes, but this does not influence the pullout.

The behavior in a tailspin of the modern fighter plane depends on many factors entering into a plane's slide. A tailspin can be static or non-static. To pull a plane out of a tailspin, it is necessary in every case to stop an autogyration by using the contra-slide foot pedal and then to pull the stick out; this will take the plane into smaller pressing angles, in which autogyration does not occur. All these procedures are the same and should be executed successively.

In my opinion, pilots are wrong trying to solve it by inside symptoms [?] or trying to establish a tailspin. This could produce great danger in taking a plane out of a tailspin; it may even make it impossible. We must remember that the plane will go out easier and without delay from a non-static than a static tailspin. It is only necessary during the plane's

momentary stall in the spin -- steering gear in neutral position -- to pull the stick virorously to the pilot, and the plane will enter into a dive.

It is my opinion that there is only one way, regardless of the circumstances causing the tailspin, to take a plane out of it. This method is discussed below.

First of all, the pilot should reduce the engine's revolutions to slow the gyroscopic momentum; then, by using the vertical stabilizer, take the plane out of the outside into an inside slide. This will brake the self-spin and reduce the momentum of the lifting forward part of the plane, under the influence of the center-force. To accomplish this, the pilot should place the vertical stabilizer in the opposite direction to the tailspin. Then, at that moment when the turn is slow and the forward part of the plane down, place the stick forward, taking the plane under such pressing angles that there will be no tailspin. At the moment when the tailspin stops completely place the vertical stabilizer immediately in the neutral position to eliminate the inside slide; this can change the direction of autogyration that is, the entrance into a tailspin of the opposite direction. With this, the entrance into a dive increases the speed necessary to continue flight.

Summarizing, we can say that when taking a plane out of a tailspin the pilot should reduce the engine's revolutions, energetically place the vertical stabilizer against and in the oppositedirection to the tailspin. After a quarter to a half of the turn, he must completely -- with the neutral position of the ailerons -- put the stick forward; then at the moment of stall in the turn he must at once place the foot pedals in the neutral position, and after acquiring a speed of 360 - 380 km/h (opposition speed) in a dive, smoothly take the plane into horizontal flight.

By following the mentioned procedures consecutively the plane will pull out of the tailspin without a great delay.

Mistakes Causing Delay or Impossibility of
Taking Plane Out of a Tailspin

The most common mistakes which cause delay or impossibility of taking a plane out of a tailspin are:

a) lack of energy or insufficient angle in the control mechanism during pullout;

b) not following the prescribed procedures consecutively;

c) turning ailerons in the opposite direction to the tailspin.

A lack of energy and an insufficient angle of the control mechanism in attempting to take a plane out of a tailspin contribute to a big delay or the impossibility of a plane's going out of it. The reason for this inadequate efficiency of the control mechanism, especially the vertical stabilizer, is an insufficiently progressive stabilizer.

Because a fighter plane has great pressing angles during the tailspin, the angle of the air-flow direction of the vertical stabilizer is likely to be that of its slant. The perpendicular constitution to the air-flow of the vertical stabilizer "Vl" (Fig 4) is very small; this is why the efficacy of that steering gear is not enough. Besides the efficacy of the vertical stabilizer is reduced by an aerodynamic shadow of the after part of the plane and horizontal stabilizer. (Fig 5)

To reach suitable aerodynamic moments, all steering gear movements must be full and energetic because of the shadow. Otherwise a plane will

not pull out of a tailspin.

Not paying attention to the succession of the required procedures will make it difficult or impossible to pull a plane out of a tailspin. Placing the stick away from the pilot, we shadow the vertical stabilizer by the horizontal, placing the stabilizer and establishing at the same time a harmful aerodynamic moment on the horizontal stabilizer.

We know that the jet fighter plane performs a tailspin on the past critical pressing angles. As we mentioned, the angle of the incoming air streams is near to the slant angle of the tail steering gear and results in the creation of an air flow "V1" which is inadequate: the capability of the steering gear is insufficient. Besides, there develops quite a large aerodynamic shadow on the vertical stabilizer, contributed by the horizontal stabilizer (specially after placing the stick away from the pilot i.e., placing the horizontal stabilizer in the downward position.)

By placing the stick away from the pilot and the horizontal stabilizer downward, the surface of the shadow increases; this cuts down the efficiency of executing the inside slide, which brakes a self-turn. During the pullout, by placing the stick away from the pilot and turning the horizontal stabilizer before or at the same time, an additional shadow enters causing a drop in the efficiency of the horizontal stabilizer. Under such conditions the plane will not pull out of a tailspin.

Placing the stick away from the pilot contributes to a gain in the horizontal stabilizer's carrying force, because in the outside slide the outside wing is in the forward position and downward; that is why the horizontal constitution of the carrying force of the horizontal stabilizer develops a very strong counteracting moment against the plane's going into an inside slide. Thus, the plane may not come out of a tailspin.

From the examples mentioned above, we arrive at the results that a quarter to a half-turn contributes to an additional drop in the efficiency of the vertical steering gear and to the rising of aerodynamic momentum; this makes passage into the inside slide difficult. The plane then will not pull out of the tailspin.

The stick should be placed away from you only after a time enabling the plane to enter into the inside spin with the decreased turn of a plane and its forward hull lowered.

The decreased efficiency of the vertical stabilizer and the harmful aerodynamic momentum will not have a great influence on pulling the plane out of a tailspin. A great influence on the plane's performance in a tailspin and especially in pulling out of it, has been the ailerons' angle; this plays a major role on the spin of a tailspin. We can establish a conteracting force to the outside spin by pulling the tail's ailerons toward the direction of the tailspin (in the left tailspin, stick to the left) and angling down a right-wing aileron, thus establish an additional braking force. At that moment the plane's irregular revolving moments will increase, which in turn develops a favorable moment for the plane to pull out of the tailspin.

On the other hand, angling the ailerons in the opposite direction

to the tailspin increases the plane's outside slide. The ailerons bent down on the inside wing act as an additional brake. In that situation the outside wing is moving more forward, increasing the outside spin. A plane starts to revolve more regularly and increases the speed angle of the turn. In that situation the forward part of the plane will gradually lift into a horizontal position and enter intensively into a flat tailspin. It shows that during the pullout, the ailerons play a decisive role. In placing an aileron in the opposite direction to the tailspin during pullout, even a quarter-movement of the stick will make it impossible to pull the plane out of a tailspin. In that instance, a vertical stabilizer is less successful and is not capable of overcoming the great counter-force needed to bring a plane into the inside spin to brake the autogyration. Thus in pulling the plane out of a tailspin, it is necessary to pull the stick away from the pilot as accurately as possible, in line with the white vertical mark on the dashboard.

The described mistakes, especially turning the ailerons in the opposite direction to the executed tailspin, will lead to delays and even failure in the pullout. Only the application of the prescribed methods will guarantee pulling the plane out of a tailspin in any situation and permit a safe landing.

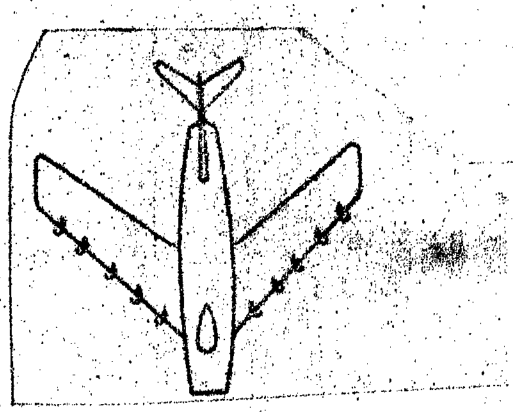

Figure 1. Bringing a fighter out of a spin.

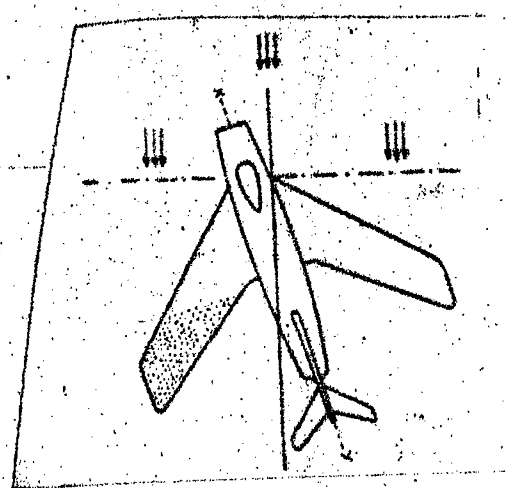

Figure 2. Spontaneous causes of going into a spin.

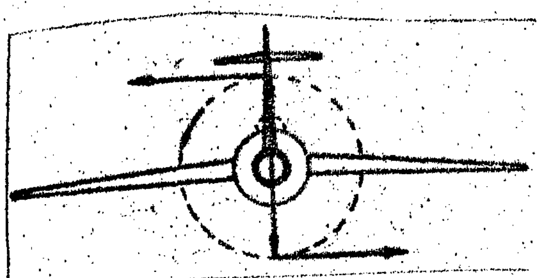

Figure 3. Action of the gyroscope moment on the plane. (On the drawing we show the plane viewed from the jet exhaust. The direction of rotation of the engine is indicated by the oblique arrow. The upper horizontal arrow gives the direction of action of the gyroscope moment when pulling the stick, and the lower arrow shows the direction of gyroscope moment when releasing stick.)

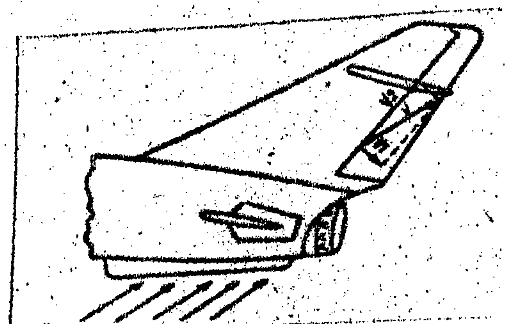

Figure 4. Air stream flow pattern about the directional steering mechanism of a fighter.

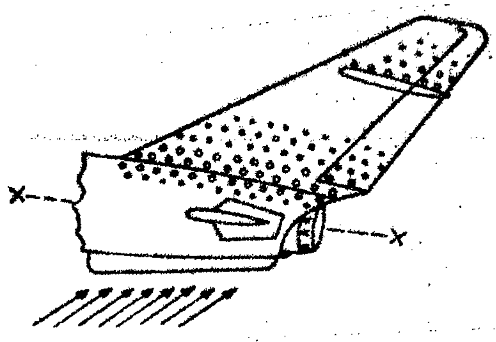

Figure 5. Aerodynamical shading of fighter plane rudder.

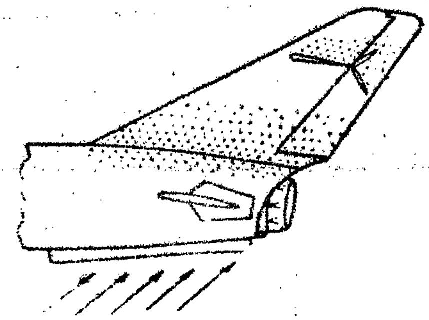

Figure 6. Shading of upper part of directional steering mechanism [rudder] after releasing stick and after deflecting the ailerons.

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PSYCHOLOGICAL PROBLEMS OF CATAPULTING

[Following is the translation of an article by Kapitan Magister R. Bloszczynski in Wojskowy Przeglad Lotniczy (Military Aviation Review), Vol XII, Warsaw, Dec 60, pages 24-29.]

Compulsory abandonment of the plane during great speed is not only a technical problem, but a psychophysiological question of a great magnitude and a major problem in the field of individual psychology.

Recently there have been many publications relating to the physiological side of catapulting. The authors are right in stressing the weight of psychical appearance, which very often affects the pilot's behavior in a difficult situation.

Modern science is expanding considerably in the field of aviation psychology. Their goal is the analysis of the psychical happenings in the pilot's profession. We observe constant development in research methods; experimental research is given a larger sphere of activity. In spite of the noticable advance in the development of aviation psychology, there are many open questions to discuss. This is natural, and results from the tremendous aviation advances. Catapulting to save an endangered life is a very complicated thing from the psychological point of view. A pilot's behavior during an accident resulting in the abandonment of the plane in the air depends on the following factors:

a) individual preparation for the profession
b) air situation
c) degree of danger
d) number of individual parachute jumps
e) psychical and physical condition

The majority of air disasters is characterized by a dynamic course of action; this has an influence on the pilot's behavior.

To understand some of the ideas which we will use, it is necessary to talk about psychological terminology. We meet very often with the term "emotion". Emotions and feelings are psychical states which reflect the "plus" or "minus" of a person's reaction to reality. Feelings are the motors of human thinking and acting. The human being is directed in his acts by his feelings, and mind in turn determines ways to achieve the prescribed goals.

Joy and depression are reflected in a change of strength, quickened pulse, changes in the circumference of the limbs under the influence of increased or decreased blood pressure, changes in the rapidity and depth of breath, mimical movements, and glandular secretions. Feelings and hidden reactions cause noticable movements in structure (arms, legs, and torso) and mimical changes, which constitue their outside expressions.

Feelings are revealed in the human voice. To understand completely the psychological structure and to show the cause of feelings, it is necessary to explain in words or to show the whole situation upon which feelings are based.

An emotional constitution will develop when a core does not execute its main functions and is not able to control its subcenters. A weakened or complete lack of the brain's control functions reacts on the subcenter's increased activity. Because of the lack of complete or partial control of the core, functions of the subcenters in the lower parts is inert, not moderate, and to a different degree uncooperative with the core's wants; in an actual situation, this might be in the human being. That is why complete emotional behavior is expressed in the inert stature. From there descends a lack of criticism, impossibility to judge one's own functions or to stop them, regulate, and immediately adjust them to the surrounding needs.

In contrast to the functions of emotion is reason. Its mechanism depends on braking the flow of the brain's core on a subcore. In this way a core stops its functions and slows some of them, namely, the ones whose actions are necessary because of the surrounding conditions. Emotional functions are not concerned with surrounding conditions, while reasoning functions, on the other hand, are accustomed to the organism's needs and the arising situations. In an emotional state we observe changes in the functions of the breathing system, alimentary canal, etc. There appears tension or limpness of the muscles, enlargment or shrinkage of the eye pupils, redness or paleness of the face. Such symptoms as perspiration, shivering, etc. could develop. Emotion is characterized by a very severe passage which overcomes a human being very quickly. This passage is stormy and explosive, but short. Because of its force, it can cause far-reaching changes in the physiological functions of a human being. There are known instances of stuttering, hair graying, etc. In the emotional states we can recognize fright, terror, and fear. The unpleasant condition we call "fright" cannot be described by objective conditions and has its sources in the specific physical contents of an object. Comprehending terror, we understand the unpleasant emotional states associated with a real situation. Fear is the greatest tension of fright.

The work of the pilot requires quick reaction on stimulation, concentration, spread of attention, analysis of an arising situation, and undertaking decisions with reference to his movements and relating such decisions to the movement apparatus for the purpose of executing corresponding functions. According to Gerathewohl, the pilot's reaction time on a touch stimulus is 90-190 thousanths of a second; on a sound stimulus is 120-180 thousanths of a second; on a sight stimulus, 150-220 thousanths of a second. In practical aviation training a pilot can reduce the reaction time on an individual stimulus. Gerathewohl says that it is possible to reduce the reaction time 70%; this includes reactions consisting of many serious problems requiring a great strain on the attention and efficiency of distinction.

Besides the speed of reaction, which is an especially important

function during catapulting, are the motor-sense movements. These movements are realized as a result of the impulses directed to all of the muscles by the central core. For example, pulling a plane out of a tail-spin is executed by the upper and lower extremities.

A pilot's movements, from the point of psychology, consist of a readiness of the functions and the execution activity.

During readiness there exist a choice, a motive struggle, an analysis of the situation, and an undertaking of the decision.

The majority of our reactions are coordinated. They need the equally and successfully combined work of the many apparatuses which enter functioning with a specified coordination and prescribed degree of strength.

The pilot's activity and movements, when forced to leave a plane, depend on the situation and degree of the danger. When the degree of danger is small (i.e., damage of the turbine at the altitude of 8,000 m), the pilot has the time to analyze the arisen situation and execute the functions which he considers proper. In that situation his behavior will be calm. He can decide if conditions will force a landing; if there are not, he will have time to reduce his flight altitude to 2,000 m and leave the plane with the help of the catapult chair.

We are interested in a more hazardous air situation, i.e., fire, collision of two planes, etc. While in the first instance the growth of the stimulating force is milder, in the second, it follows a very dynamic course. A dangerous situation arises suddenly, and a plane loses part or all of its aerotechnical ability. Not being prepared for it, a pilot will not always be able to discern the reason and the degree of danger. A dangerous situation is a strong stimulant which causes the development of fright in the pilot. In that situation, the pilot starts to react on the steering gear. Under the influence of the feeling factors, only the prescribed notions suitable to the fixed feeling in that dangerous situation are executed. In individual mishaps there could develop situations of passive defense. One moment, the pilot might appear as entirely unmovable, then could develop in individual cases a panic reaction to escape. A great tension of fright emotions will develop physiological symptoms, owing to the existing connections in the nervous system between the passive defense and motor centers. The complete helplessness of an individual overwhelmed by fright is caused by a stop in the skeleton-muscular structure. Of course, the degree of emotional tension in an individual mishap will be different, depending on the type of the pilot's nervous structure, his professional preparation and many other factors.

The individual's behavior always depends on his emotional state. In a normal situation, our consciousness is not subject to hesitation, and depends on intensive changes (intensivitas). To these changes we can add the shrinkage of the field of consciousness. These happenings are physiological in the emotional states of fear, fright or rage. These states might also arise in the pilot when compelled to leave the plane. In that situation, all attention is directed only in one direction; side perceptions do not reach the conscious currents, but perceive and track only one thing. We can compare this state to that of a reflector which lights everything in its path, but leaves the rest in darkness. In this

state a human being could forget to react to pain and cold, and lose his orientation in time, place, and his surroundings. These symptoms appear with great pressure on individuals unprepared for their profession, and showing a lack of stabilized emotion.

In the first phase of the compulsory abandonment of the plane, there could appear in the pilot the following symptoms:

a) fear (psychical shock reaction), of which the chief cause is the force and suddenness of the stimulant.

b) psychical helplessness, a state of deep restraint and forzen movements.

c) a greater or smaller narrowing of the conscious field, depending on the suddenness and force of a stimulant, danger state, preparation for the profession, and the type of nervous system.

d) movement excitement; this is characterized by a reaction on the steering gear.

The outside symptoms of this reaction could be listlessness, shivering, prespiration, and quite often, uncoordinated reactions.

A real danger which could develop during catapulting is the probability of receiving physical injury of the upper or lower extremities and the spine. These injuries will develop when a pilot does not execute all his prepared motions according to instructions.

During the training and schooling, pilots are working out and strengthening the necessary customary procedures arising during compulsory abandonment of the plane. Thanks to the systematic repitition of the same reactions, the degree of accuracy increases. Accuracy is less when a pilot does not have all procedures worked out. It depends on the training intensity and pilot's physical state.

There could arise symptoms of noncoordination of habit under great emotional tensions. Emotional symptoms are looked upon as the main cause of mistakes executed by a pilot. In a situation when a plane looses its steering ability and is going toward the earth, the pilot should leave the plane immediately. Every second lost contributes to the increase of speed and loss of altitude. That is why it is necessary during the process of training to pay more attention to the pilot's preparation on the ground. Each pilot should learn to execute the necessary movements during training.

During training on special installations, it is necessary to watch the time between the order to jump and the moment of setting the release in motion. The speed or delay could show a negative emotional state. Training must be performed under the same conditions as in actual situations. The pilot should wear a parachute, helmet, and oxygen mask to reconstruct the same conditions as are in the plane's cabin. A deviation from this principle will develop a loss of habit automation. For example, when such conditions are not observed, movement and distance will be different in the upper extremities than when a pilot wears a parachute and is fastened by belts. Many times, pilots do not appreciate this and disregard the way they have been trained on the ground.

During the period of preparation to abandon the plane, the following symptoms could arise:

a) great emotional strain,

b) less automation of the learned habits,

c) a lowering of the pilot's whole sensitivity. (Even a wound received in such state will go unnoticed for a long time.)

The real problem it is quite often said, is that a pilot may lose consciousness after catapulting. Experimental catapulting shows that this is not so. From the physiological point of view, it cannot be confirmed that such a state is caused by the high speed. Despite the fact that the value of speed in the head-pelvis direction is great and could reach 20 g's the existing time is so short that the blood does not have time to shift to such a degree as to cause loss of consciousness. Diagnal speed also will not cause such a state.

The best description is half-consciousness; in that state, consciousness is very slight. The greater the tension of fear, the lesser the field of consciousness. Thus, the whole strength of the system joins togetherto oppose surrouding conditions. In the period of strongest psychomovement, emotion could be checked by oblivion.

Having directed our attention to the physiological factors, it is necessary to acknowledge that the major condition contributing to half-consciousness is the fear emotion a physical shock reaction which could in turn lead to psychical injury. The feeling of such a state will be quite different, depending on the individual.

We can observe the likely manifestations in the flying personnel during training parachute jumps.

Reasearch carried out in the USSR enabled us to learn the part emotion plays during an arisen motor disturbance. For example, doctors noticed in the jumpers a faster heart-beat, shaking of the hands, and high blood pressure in the first days of training. So the question arose: is this a negative result of the executed research, or fear reflexes? This is why the doctors adopted the ideal experiment. They put one of the jumpers in the chair, and when he was prepared to execute a task, instead of the order "jump!" there was a "halt!" When the jumper left the cabin it was confirmed that he had the same symptoms mentioned above. The doctors executed another experiment. The jumper was informed that during catapulting, the full acceleration force will affect him; however, the realization that force was smaller. In some instances the action was reversed. All trials showed that the reaction of a jumper was contributed to, not by realistic acceleration, but by the one he was expecting.

After landing, the fear emotion could show as shaking, strong perspiration, overall weakness, satisfaction of a good jump, and observation of physical injuries. Injuries in aviation mishaps are not limited to physical changes. There are known examples of great injuries which were strictly psychical and often incurable. However this is a problem which needs separate discussion.

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GENERAL DIRECTION OF THE DEVELOPMENT OF CONTEMPORARY MILITARY THOUGHT

/Following is the translation of an article by Brigadier General Franciszek Sibinski in Wojsko Ludowe (People's Army), No 3 (130), Warsaw, March 1961, pages 17 - 23./

The camp of socialist states believes (and confirms this practically) in the possibility of settling all international conflicts by peaceful negotiation, in the principle of the peaceful coexistence of various organizations, and also in the possibility of precluding recourse to war between nations. These convictions, however, are not shared by the capitalist world, in view of which -- without regard for our own objectives -- we are forced to make preparations for repelling the threatened aggression with force or to prepare for war. Consequently, we note a general effort by the military to define the theoretical premises which would make possible the best preparation for the new conditions of war in order not to repeat the mistake committed by some states during the period preceding the last two world wars.

The basis for sound solutions should obviously be brought as closely as possible to the reality of defining the entire complex of modern combat and war. It begins with the necessity of arriving at a common answer to a basic question: will the eventual next war be nuclear? If so, will it be a global war, or can the use of nuclear weapons somehow be curtailed?

It appears that the answer to this question can be formulated as follows:

It is entirely certain that in no case will our side start a general war; particularly it will not begin a nuclear war. There is also no doubt that in the event of a conflict the capitalist side will resort to the use of nuclear weapons. (This is evident not only from many public utterances by high public officials and other responsible representatives of the capitalist world, but also from the definite organizational undertakings taking place in NATO forces.) It appears that in view of the range and radius of the destructive power of nuclear weapons, all hopes for some kind of limitation of war are not within the framework of realistic calculations.

There can be but one inference drawn from this: he who does not want to be taken by surprise must prepare for the entirely new form which modern nuclear war will take, not only from an operational and tactical standpoint, but also from the economic, political, and strategic standpoints.

Let us concentrate our attention on a summary of the most vivid and easily comprehended changes involved in the process of total preparation of the Armed Forces for modern war: the rocket cadres, the infantry, the Air Force and "OPL OK" troops, and the naval force,

Concrete beginnings in this area, costing much effort and money, are the result of mental efforts to limit the above-mentioned conditions of a nuclear war.

During the last ten years, theory in this respect has undergone a distinct evolution. In the beginning the initial prospect of equipping armed forces with nuclear weapons produced complete chaos among military theorists and led to extremely divergent opinions and propositions. At one extreme were the theorists who considered nuclear weapons as absolute weapons (yet once more in history emulating the example of Douhet) which alone would be able to decide victory without participation by conventional armed forces. On the opposite extreme were found the pessimists (e.g., Miksche) voicing the theory that the use of nuclear missiles would in a very short time produce a return to archaic forms of war in which victory would be attained by infantry masses equipped with primitive weapons. Between these extremists there oscillated a whole series of in-between opinions.

There was a point in history when the United States (together with her allies), preparing aggression against the Radziecki Alliance and the socialist countries, possessed an atomic monopoly; in a short time, nucler weapons were acclaimed by the West's political and military leaders as absolute weapons. The apparent upshot of such an attitude was the diversion of all effort — at the cost of conventional military forces — to the development of nuclear weapons and the means of transporting them to their target. Conventional troops were regarded as suitable for the role of occupation and police forces in territories captured through the use of nuclear missiles.

From the moment of losing not only its monopoly but even its position of leadership in nuclear missiles and rocket techniques to the Radziecki Alliance, the theory of absolute weapons turned against its believers. The new situation of a reciprocal counter-balance of war potential caused an evolution in opinion, summarizing itself in such slogans as the doctrine of "sword and shield" (in which the role of the sword was to be played by strategic thermonuclear missiles; as for the shield — the military forces of NATO armed with tactical atomic weapon), and the doctrine of atomic deterrent and retaliation. Simultaneously, there arose in the West abundant theoretical literature endeavoring to find an answer to the tormenting dilemma which can be summarized as follows: nuclear war by both sides creates a threat of a "war without victors." The solution depends reducing, with the help of political and military measures, modern war to a form which would assure victory without simultaneously leading to the complete destruction of both combatants.

The majority of authors (among whom we name Dr Kissinger, General Gavin, Osgood) propose a solution which depends on conducting a form of "limited war." "Limited" is to be understood as the transfer of military activity to the "periphery" and very strictly limited military action in the military theatre (the method of an indirect strike), or the voluntary and reciprocal restriction on the use of nuclear weapons for targets of a specifically tactical "operational"

character [See note], or a combination of both categories of restrictions.

([Note:] Which, however in practice appears to be extremely difficult for both sides to observe if a complete prohibition against the use of nuclear weapons does not follow.)

Summarizing and simplifying the case, it can be said that in this last period, military theory as well as the realistic undertakings of the general staff are evolving toward a restoration of a certain balance between the nuclear missiles and conventional military forces (equipped with nuclear weapons of a tactical and operational type). This simultaneously signals a progressive loss of faith in the "absolute" value of nuclear weapons.

Realization of this state of affairs is simultaneously an affirmative answer to the question of whether the necessity exists for the maintenance of costly conventionally-armed forces. Such a necessity exists for this in a very unquestionable manner. There also exists the necessity of adapting the Armed Forces in every way for the conditions of atomic war.

Let us examine the most characteristic moments in the evolution of contemporary military thought with reference to individual kinds of military forces. We will pause here on the tendencies observed in the course of operations, tactics, and structural organization: on the other hand, questions relating to strategic problems will be treated in a very general way.

The first problem in this area is the matter of defending the national territory primarily from the weapons of mass destruction. The basis for resolving all of the problems related to this question is the assertion that in view of the actual state of technology there still is a possibility for actively combating an enemy's air force and certain strategic aerodynamic rockets (but only those whose speed does not exceed Mach 1-2 M). On the other hand, the tests conducted by the West to overtake ballistic missiles have not yet produced any satisfactory results. Therefore, active combat of these means the preventive destruction of the enemy's missile sites as well as the disruption of his system for directing rocket flights.

All these precautions demand first of all the construction, maintenance, and proper utilization of a network for detection and warning. In particular, the detection system must be projected as far as possible into the flight path of the enemy's rockets and systematically deployed throughout the length and breadth of the land. The system must be organized into a united whole within the boundaries of the entire coalition. It serves not only as the active, but also the passive, territorial defense measure. Among the latter, to name a few such as the dispersal and concealment underground of key industries, the preparation for the evacuation of key Government institutions, the construction (during peace time) of atomic shelters, the organization of forces and measures especially assigned to liquidate the results of nuclear blows, etc.

A second category of preparations of a strategic character is a derived forecast relative to the manner of the outbreak of the eventual future war. Everything points to the aggressor is endeavoring to exploit a surprise attack to the maximum; he will therefore strike violently, with confidence, without a formal declaration war, without official mobilization and concentration, striving (just as did the Hitlerites in 1939) to nip in the bud any mobilization or concentration by the assaulted side. The result of these forecasts will be such a state of military preparation as would permit military action without mobilization or concentration. [See note] Linked with this is the necessity of having two categories of armed forces (this refers primarily to land armies):

1) attack troops, constantly kept at full strength, fully equipped, and deployed while still at peace in a manner best suited to military strategy;

2) defense troops, mobilized (at least partially), and assigned to supplement the attack force, to combat aerial and naval invaders, to fight diversionary battles, and, finally, to liquidate the effects of massive nuclear blows.

([Note:] As will be evident later, the term "concentration" no longer has the same significance which we attached to it as recently as the year 1945.)

Land Forces

If, on the basis of experience obtained thus far, we wish to formulate intelligently a proper basis for waging modern war and operations and also to acquire some logical ideas pertaining to the arming, outfitting, and the organizational structure of land forces, we have to base our decision on the analysis of the probable role of atomic weapons on the field of combat, from the point of offense as well as defense. Correct analysis based on knowledge of the facts should lead to obtaining a more realistic idea of the conditions of atomic war and what comes afterwards — to maximum preparation in all respects for the changed war form.

The chief principle of the universally accepted proposals and opinions has become the general thought of getting the maximum benefit from the power of one's own atomic missiles and at the same time adapting all tactical and technical methods and means to reduce to a minimum the influence of the enemy's atomic missiles on our own forces.

The new phenomenon has created a new idea known under the name of "worthwhile atomic target" (it is characteristic that with the passage of time, demands respecting the sizes of such targets become ever more modest; in the beginning phase this goal was no less than a concentrated regiment; today there is already talk of a company). In conjunction with this, a new fundamental tactical principle emerges: never create a worthwhile atomic target anywhere; maneuver so as to force the opponent to create a target for our missiles. The term "worthwhile atomic target" is, after all, a matter of subjective value.

The fact, however, remains that from the point of view of the ease of striking a target, a static target is much more vulnerable than one in motion. Moreover, engineering works considerably lessen the range and degree of effectiveness of nuclear missiles; much significance also attached to armored tanks and transport vehicles. Thus, the fundamental canon of modern tactics becomes a "triad" composed of the commands: decentralization, mobility, and an engineered terrain. Finally, common sense shows that close contact with the enemy will make impossible (at least it will complicate) the use of atomic missiles against us.

The phenomena and commands of atomic war named here often conflict not only with each other but with the basic principles of "classical" military doctrine (e.g., conflict between the mandate for decentralization and the concentration of forces for the purpose of attaining superiority in a given place). Hence, the operational and tactical art of the atomic period has the accomplishment not only of working out those forms of operation and combat which would allow some kind of compromise with the conflict but also the best possible advantage from the tremendous victory potential which is hidden in the new combat media.

The universally accepted (with various shadings) actual /See note/ opinions relative to resolving the most important questions in the area of the land forces military strategy can be summarized as follows.

(/Note:/ This does not mean "final" or even "permanent".)

In utilizing various troops (and services), the greatest possible decentralization is obligatory (to the extent permitted by other considerations) down to the level of a company. Concurrently, still greater significance must be attached to the principle of the passive and active camouflage of troops, services, and intentions.

The principle of decentralization entails far-reaching consequences: a division assembled in a concentration zone (in reserve) formerly occupied an area of approximately two square kilometers. Current norms describe such a zone as an area comprising several hundred square kilometers and in addition enjoin the maintenance of a distance between divisions equal at least to the explosion-diameter of an atomic missile. A proposition which can be stated in mathematical form implies that if the surface of a given military theater of operations encompasses x km^2, and the area of the zone of concentration of a division is y km^2, then the capacity of that theater is calculated from the equation $x:y = a$. /See note/

(/Note:/ The whole problem is greatly simplified and applies only to divisions.)

We know that value (y) has now grown several tens of times: arithmetic therefore shows that value (a), or the capacity of every military theater, has shrunk that same number of times. Besides, some military theaters simply cannot physically accomodate as many divisions as was possible, for instance, in the year 1945. /See note/

(/Note:/ This opinion is one of the factors influencing decisions as to the number of divisions required for actual military operations.)

During breakthrough operations in World War II, a division

attack-area sometimes extended up to two kilometers. At present one cannot talk about such troop density. The foreseeable attack area norm has been increased several times, and even this is likewise considered a density which can occur only temporarily for the short duration of the attack itself. Troops should be concentrated on the very perimeter of the contact point, approaching it rapidly, and after the breakthrough should immediately extend the attack area, dispersing fan-like (in military literature such procedure is called the method of the "double funnel").

The above procedure is one (but not the only) method for resolving the conflict between the necessity of decentralization and the need of creating superiority. The basic means of attaining true superiority is the explosion of one's own atomic missile, aimed at the proper target at the proper time. It would be pertinent at this place to say that atomic power is in general the fundamental factor of every projected maneuver, aggressive as well as defensive.

In defense, the understanding of the principle of decentralization likewise caused a considerable extension and broadening of the hitherto normal rules.

All measures having as their object the fulfillment of the command "decentralize" have a defensive character. They have the task of minimizing the effects of the enemy's atomic missiles. It might seem that extending the sphere of action entails automatically weakening the power of attack and defense. In reality, there exists a factor which permits the adoption of the decentralization procedure without the risk of weakening combat potential; this factor is one's own atomic stock pile, because of which the strength of our fire compensates many times over the results hitherto obtained by utilizing massive forces and conventional sources of artillery fire. This particularly concerns artillery, whose density in times of certain breakthroughs during the last war probably exceeded 200 - 300 barrels on a given attack kilometer; under current conditions this is a prohibitive concentration of equipment and people. One atomic missile constitutes the equivalent of an absolutely astronomical number of artillery shells measured not by carloads but by trainloads. Thanks to this, it is possible to reduce conventional artillery substantially.

The phenomenon of the unheard-of-growth of fire power permits the utilization of a very swift attack tempo with a simultaneously depth of offensive operations. In military literature, contemporary attack tempo is defined as several tens of kilometers daily. Not only is this defined, but it postulates attainment of such tempo in order to fulfill the condition of mobility. This not only with the object of obtaining another (besides decentralization) method of avoiding the enemy's nuclear missiles, but above all with the object of routing the enemy as quickly as possible. Through this, avoidance of atomic blows will also be accomplished. Rapid penetration deep into the enemy's concentrations will deprive him of the use of at least a part of his atomic missiles. This is very important, because each of those missiles utilized in the proper (from the enemy's viewpoint) place and time can

curb our attack.

Characteristics of defense measures present the possibility of benefiting from a third method of protecting decentralized troop concentrations from atomic blows, that is, parenthetically speaking, the engineered preparation of the terrain. This method should be exploited as extensively as possible even during offensive actions; we are aware, however, that the possibilities in this instance will be considerably fewer; science and engineering can help by designing and producing special equipment for the armed forces.

Modern defense does not resign because of a second factor: mobility, realized first of all in the form of counter maneuver and likewise in the form of concealed changes in occupied regions.

The dominating role of atomic weapons therefore prompts qualitative changes in the forms of operation, combat, and troop disposition. There has emerged a need for adapting them to their new role, to new means of accomplishing their tasks. This goal is reached by comprehending the new concepts in arming and outfitting troops and providing them with the most suitable orgainzational structure. In the technical area the claim of mobility and maneuverability of all kinds of troops and services is attained above all, thanks to their complete motorization (mechanization). Technical effort is being directed toward freeing troops from dependence on roads and, to the extent possible, from transportation problems. This means equipping troops with land and amphibious transport vehicles and also to diverting a substantial part of supply and evacuation to air transport.

The most characteristic undertaking in the area of armaments is the replacement of a substantial (but not yet the entire part of artillery of various types, anti-aircraft as well as anti-tank, guided and self-guided rockets with TNT or atomic war heads. It is here that the reason for the astronomical growth of the fire-power of modern troops is to be found. The amount of communications equipment, particularly radio, being furnished the armed forces is on the increase. Troops are equipped with electronic gear used for scouting, communications, and automatic fire control. Noctovision and television is being adapted ever more widely. Highly specialized equipment is being introduced into the military forces to detect contamination. As far as organization is concerned, it would be necessary to create entirely new kinds of military forces — above all, detachments of rocket cadres and also special small units responsible for scouting and liquidating the effects of nuclear blows. Great changes also concern "pre-atomic" type of troops (and services). The most important of these changes are:

1) the tendency in the land forces to increase the proportion of troops in the armored divisions (since the tank is relatively less susceptible to the phenomena of atomic combat);

2) the increase in the significance of paratroops (these among others constitute a factor in speeding the tempo and broadening the scope of attack, as well as being a factor in diversions conducted in the course of defense operations);

3) the increase in importance, the qualitative and quantitative

changes in the troops serving the network of detection and warning;

4) the increase in the significance of the changes in supply and mechanization of the engineer corps, upon which to the highest degree depends the maneuverability of one's troops;

5) in the line divisions (armored and modern infantry) the tendency to sometimes create completely new structural concepts, the tendency to subdivide those divisions into self-sufficient units — composed organically of all the most important arms and services — as well as the tendency to liquidate certain traditional command elements.

Besides this, it is possible to assert that there is no area of life or combat in which it would not be necessary to adapt to the new concepts of war. This applies even to uniforms, personal equipment, and feeding the individual soldier. To conclude this chapter, it is necessary, however, to supplement its basic assumption. Primarily, it concerns the fact that the dependende on war measures — and everything which results from them — stemming solely and exclusively from technical development would be an excessive simplification of the problem.

This dependence is obvious, fundamental, and indubitable. However, the degree and interpretation of the practical advantage of this dependence depends also on a series of other factors: in particular, on the tasks and policy goals each state sets for itself, and on the entire military situation. /See note:/

(/Note/ I am not speaking about the economic or technical situation because these are linked with an understanding of the development and realistic comprehension of technical possibilities.)

However, let us turn our attention to a presentation of the most concrete examples in which — independent even of identical technical situations -- the approach to the problem of military preparedness in the capitalist states is completely different from that of the socialist states. We perceive beyond this considerable differences in adjusting to the problem in the capitalistic camp, even comparing the reigning opinions of states which are members of the same aggressive coalition, such as NATO or SEATO.

Air Force

The problems of the development of the air force are closely tied with questions of anti-aircraft defense. These two matters possess many points in common.

The primary factors which effect a direct or indirect influence on the developmental tendency of various kinds of planes are rocket and atomic missiles.

The direct influence is dependent on the fact that the rocket can be regarded as an aerial source for the transportation of a military warhead: besides this, a source (ballistic rocket) capable of much greater speeds, ceilings, and ranges than piloted aircraft. At the same time, it cannot be destroyed by present methods of anti-aircraft defense. This explains the tendency to replace long-range strategic bombers with strategic missiles. A second factor influencing the displacement of

strategic bombers by rockets is the advance in the effectiveness of the anti-aircraft rocket. Previously in order to shoot down a single plane it was necessary to use several hundred anti-aircraft shells; currently, we are approaching a state of technical perfection which permits application of the calculation: one anti-aircraft rocket for one plane (not exceeding the speed of 2 M). Insuring the nation's skies against attack by bomber planes will become in the near future a problem only of establishing a sufficiently strong rocket shield linked, of course, with a modern network of detection and warning.

The indirect influence becomes evident by the necessity of adapting aircraft to the new tactical and operational procedures of the land forces which have arisen as a result of the appearance of new instruments of combat. This, first of all, concerns aerial assault and support planes (transport, liaison, and scout).

Currently, the rocket is displacing (although it has not yet displaced) the strategic bomber plane; in other words, a plane which is used primarily both for large and static targets. Here the piloted plane can be effectively replaced by the rocket. It is not possible, on the other hand, to substitute the rocket with the fighter-bomber in supporting the efforts of the land forces and attacking (with, among others, atom bombs) primarily moving and sometimes hard-to-hit targets.

Definite manifestations of changes taking place in the air force can be stated as follows:

We observe a lesser (in the USA) or greater (in Great Britain) tendency to replace strategic bombers with rockets. Simultaneously, however, this type of plane (in the USA) is being perfected. Efforts are proceeding to increase plane speed from under 2 M (to around 2.5 M, something which is encountering much difficulty), as well as equipping planes with an air-to-ground rocket. For instance, the American missile-rocket "Hound-Dog" is to be fired by a plane when within 600 kilometers from its target. For scouting targets of strategic significance, the Americans plan to benefit from a scout-type satellite, e.g., "Santos."

Fighter planes and fighter-bombers are and will be aircraft of supersonic speeds. A major problem, currently resolved, is that these do not need long concrete runways (from the standpoint of the ease of their detection and destruction, and the tempo and range of land troop-operations) for take-offs. The possibilities of building planes which take off and land vertically and maintain supersonic speeds in horizontal flight are being examined. Prototypes are already in the test stage (Coleopter).

Fighter planes assigned for anti-aircraft defense have been armed with rockets of the air-to-air type. The firing of a salvo consisting of about 100 rockets guarantees the destruction of every bomber.

A media not known during the second World War, the helicopter, is being introduced on a massive scale in armed forces all over the world. Many tasks are foreseen for it: observation (particularly televised), transportation of diversionary and tactical guerrilla units, participation in supply, evacuation and engineering work (bridge building, mine sowing), as well as a direct part in combat, i. e., in the

role of an aerial artillery post for guided anti-tank missiles. Over and above this, transport media are undergoing experiments which could be called amphibious, ground-aerial platforms capable of aerial flight, and flying cars. Prototypes are undergoing tests; these could play a major role in future combats.

Navy

The changes taking place in the structure and composition of the navy are being accomplished primarily as the result of man's harnessing of nuclear energy and the development of rocket techniques.

The influence of nuclear energy on the armed forces, already discussed, narrowed down to two points: the enemy's nuclear missile attacks, and the exploitation of our own missiles. In the naval service, we are currently concerned with adapting nuclear power to naval vessels. All three of these problems must be examined together as much as possible.

There exists beyond this a specific feature in naval development. That, primarily, is the enormous dependence of its structure and composition on the character and general nature of the national economy. In particular, it is concerned with the basic differences between continental and maritime powers, as well as those dependent on overseas imports. An extreme example of such dependence is Great Britain which has to import (over ocean lanes) 60 - 95 % of her most indispensable raw materials. The suggestions arising from an evaluation of the elements belonging to the first (atomic and rocket) category of military phenomena frequently are in sharp conflict with those resulting from the necessity of massive imports.

The characteristics of naval atomic war are as follows:

1) one atomic bomb can destroy the largest units located within the radius of the bomb's effectiveness;

2) the likelihood of hitting a ship and the striking effectiveness of an atomic blow rises proportionately to the height of a ship's gunwales and deck;

3) a deeply submerged submarine is difficult to locate and considerably less vulnerable than a surface ship;

4) rockets -- from the standpoint of their range and fire-power -- are displacing naval artillery to a still greater degree than the artillery of the land forces;

5) the adaptation of nuclear power has considerably increased the combat value of the ship and in particular the submarine.

On the basis of what we said above and on the basis of our analysis of the last war, the conclusion must emerge that the era of huge battleships and heavy cruisers has ended, and that the era of the great aircraft carriers is ending. Furthermore, the submarine is becoming the principal type of ship. In addition to submarines, small fast units equipped with rockets (pursuit craft, torpedo boats, corvettes, frigates) may have the best chances for survival and the possibility of effective operation.

Observing the definite changes in the structure and composition

of the navy, we assert that these inferences are respected to a greater or lesser degree throughout the whole world. The line ship, the cruisers, and — in part — the large aircraft carrier are destined for the scrap heap. On the other hand, major efforts are being directed to the building of submarines. Among these, the atomic ship is the major attainment.

The adaptation of nuclear power brought about a revolutionary change in the value of a submarine. Theoretically, the range of an atomic submarine is unlimited. It can remain under water for several months and can travel submerged at speeds of up to 30 knots (let us add to this the ability of the newest types of submersibles — independent of atomic power — to submerge to a depth of 300 meters).

Such a vessel, armed with ballistic rockets with a range of approximately 1200 kilometers, becomes a strategic instrument — a mobile nuclear missile site which is difficult to locate and destroy. We know that the United States has several such vessels equipped with the "Polaris"-type missile. We know from the words of Premier Krushchev uttered recently in Luzin that the Radziecki Alliance likewise possesses the same kind of equipment.

Modern submarines can currently perform many kinds of tasks. Besides strategic vessels, there are torpedo-carrying submarines and special submarines (e. g., to combat enemy submarines). It is necessary to admit that in the future the majority of naval vessels (including transport ships) "will go under water."

Paralleling the development of naval ships, naval aircraft, and shore artillery (both of the latter forces are adapting rocket techniques for their purposes), work is taking place on perfecting naval instruments of war (torpedoes and mines), as well as on improving measures for combating modern enemy torpedoes and mines.

Modern war ceased being a war of uhlans and grenadiers and even of aviators manning planes at speeds "up to" 500 kilometers an hour; it has become a war of brains — a war which can be won or lost in laboratories, educational institutions, and factories.

From this, however, one cannot in any manner draw the conclusion that man's role has in any degree been reduced. Man not only produces but serves machinery and benefits from its operations.

We know that a person defending his own country and people — in educational institutions, in industry, in the armed forces, and at the front — will triumph when he is aware that he is serving a just cause.

We do not want war, but the current state of political affairs does not permit directing all of our efforts, the sum of the nation's physical and mental effort, to the development of an exclusively peaceful character of life or to an improvement in our country's standard of living. We must prepare to defend ourselves before the ever-possible aggression by the imperialistic and retaliatory armed might.

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DEPLOYMENT OF SUBMARINES AGAINST ENEMY SEA COMMUNICATION LINES IN A CLOSED SEA

[Following is the translation of an article by Capt (Navy) Zdzislaw Frankoicz, Dypl., in Przeglad Morski, Vol 14, No 3, Gdynia, 1961, pages 14-22.]

The Second World War taught us that fleet operations in a limited naval theater depend on the development of land operations in the adjoining coastal regions. Possession (or not) of the coast and the extent of coastline held becomes important when considering military operations in a limited naval theater and the nature of the deployment of the fleet.

The rapid technological progress in the postwar period has rendered a successful operation of the armed forces dependent, to a still greater degree, upon supplies. Every military operations is doomed to failure unless it has a systematic and adequate supply system.

Bearing in mind that the capacity of land roads is limited and their availability small because of existing mass-destruction weapons and guerillas, supplying the armies by land is insufficient. Nor shall the problem be solved by an airlift, as the volume of supplies requires the organization of air bridges and these, in turn, a large amount of effort and equipment. Thus, one is forced whenever possible to use the seaways, which are relatively little vunerable to mass-destruction weapons and readily permit the transportation of arbitrary quantity, kind and load.

Notwithstanding that the modern military operations are characterized by a rapid change of conditions and large transfers of forces, the importance of a limited naval theater has not decreased, but is quite the opposite and merits special attention. Analyzing the suitability of the above-mentioned theater for operations of one particular kind of seagoing forces, one should take into account its characteristics, which may or may not enhance the operation.

Of decisive influence here are the geographical and hydro-meteorological conditions. They are the cause of many problems which arise in connection with the organization of sea transports and the deployment of submarines to combat them. The most important of these conditions are: the coastline and its formation; the number of islands, straits, and ports and their goods-handling capacities; the sea depths; distances between ports; the seasons; the length of the days and nights; the question whether the area freezes in winter; the number of stormy days; the strength and direction of the winds; the temperature and transparence of the water; sea currents; the formation of water layers;

and the question whether the phenomenon of a sound channel appears, and if so, at what depth.

Deploying the Fleet in Combat

In a limited naval theater it is most rational to deploy small surface craft, submarines, and air forces. Using ships of the destroyer class is risky, as it has been found by experience that these vessels have "too little room." One should consider that mobile rocket batteries will be widely used, which, in this case, may be deployed to advantage. A useful part shall be played by technical observation, which, because of the particular type of war theater, may be organized with ease and when used with skill shall yield untold advantages for carrying our operations. In many cases the most interesting sea areas may be embraced by the range of technical observation means, which shall in large measure facilitate the deployment of arms to strike against enemy forces. Realizing that these operations shall be conducted with the above-mentioned forces, it is to be expected that they shall proceed in an atmosphere full of tension, and that they may be very important for the participants.

In accordance with the strategy of some sea powers, the mastery of the sea through the annihilation or blockade of the enemy fleet, permits control of enemy sea communication lines and simultaneously renders the enemy unable to operate against one's own sea communication lines. To maintain control of a limited war theater at sea depends, above all, on geographical conditions and the range of arms.

Organizing Sea Transport

The possibility of deploying racket weapons en masse, whether with classical warheads or special ones, and the possibility of organizing a well-developed technical observation system necessitates the search for a new method of organizing sea transport. In modern military operations, because of the constant threat of attack by mass-destruction weapons, the potential enemy in organizing a convoy shall be forced to decentralize his transports or to use a stream system with high-speed transports. This lessens the effectiveness of all defense measures, especially anti-submarine measures.

One should assume that sea transports will be conducted by small groups of small-tonnage transport vessels with accompanying anti-submarine protection. It may consist of sub-chasers and air forces based on coastal airfields and equipped for anti-submarine warfare. In directions whence the attack is most likely, the convoy may be protected by a striking force of small vessels and supported by mobile batteries of rocket artillery. It is to be anticipated that the enemy, as much as mining will permit him, shall attempt to exploit near-to-coast communication lines for his sea transport. They shall be protected by anti-submarine precautions, which according to region shall have their emphasis on stationary or mobile anti-submarine weapons.

Deep sea voyage by transport vessels shall be undertaken only under special circumstances, as for example, to supply an established beach-head on an enemy coast.

Anti-submarine Defense of a Small Convoy

The defense of a small convoy against submarines has a defensive operational character. Within the framework of a limited naval theater it is difficult to have such a defense developed in depth, thus rendering it impossible to detect in time a submarine attacking or intending to attack. One should then assume that when a convoy or a single transport vessel passes, the enemy shall organize the most dangerous directions preliminary and systematic submarine search, deploying here the chasers and anti-submarine air forces. This shall force the submarines to remain submerged for a long time and thus to waste energy which would otherwise be used for attacking, lose contact with the enemy, maneuver to come within striking position again, or probably stay away from the pursuer.

Direct defense of a small convoy against submarines shall, most probably, be set up on the region method. Each region shall have allocated units capable of detecting and destroying an attacking submarine. Such a squadron may include chasers and an air force; the depth of such a defense may vary according to region, between 6-15 nautical miles.

Use of Submarines in Combat Against Enemy Sea Communication Lines

One should assume that submarines with torpedoes shall be used against sea communication lines. Their tactics shall depend on the mode of organization of the sea transport. Should the enemy choose the convoy system, best results shall be obtained by executing a mass torpedo attack against the transport vessels in the convoy. In the case of a stream system, best results are obtained by single torpedo attacks. One should mention here that using submarines against enemy sea transport is a difficult operational task requiring the provision of safety for the crews of the submarines and their good training.

Reconnaissance

To reconnoiter enemy communication lines requires a systematic, fast and reliable information relay on the intensity of transport, formation out of port and at sea, time of sailing from port (or region), probable port of destination (region), etc.

If we realize that this information should be received despite the season, day or weather, then we shall realize that it requires a good and efficient reconnaissance organization which should employ means suitable for the task. Generally speaking, most suitable for this task are air forces, submarines, and small, fast surface craft. Deployment of these elements is conditioned by the region, the time, and the countermeasures of the enemy; by his formation (which may also be

directional) or the position or area in which he is located, and the time of detection.

Submarines in Combat in Sea Communication Lanes

In modern warfare the best way to combat enemy convoys is to use submarines in small squadrons. Actually, it is not a new idea, as already during World War II it was tried out more-or-less successfully, e.g., the German wolf-pack tactics. Analyzing the meager comments in the foreign press, one is led to believe that this method is being perfected in order to effect mass torpedo attacks against transport vessels or warships. One should emphasize here that submarine squadrons shall be few in a limited naval theater and may be spread along enemy sea communication lanes or along the rought course in the secto r of probable convoy courses. Thus one shall obtain a constant submarine menace which, in turn, shall force the enemy to concentrate heavily his elements to defend the convoy or his communication lines against the submarines and thus to spread his forces. The enemy shall be unable to concentrate his efforts in the directions from which a threat is most likely to occur, thereby decreasing the probability of destroying the submarines. A constant defense readiness against submarines has a detrimental effect on other convoy defenses. The utilization of small groups of submarines, however, requires the ships to be in a good mechanical conditions, with well-trained crews.

This method, among other things, possesses the following advantages: it increases the effectiveness of submarines against antisubmarine defenses, aids in breaking through the convoy escort, permits the execution of a simultaneous mass torpedo attack against the convoy, and hinders the pursuit of the spotted submarines by the escort.

Assuming an Attack Formation Against Enemy Sea Communication Lanes

An attack formation should depend on the organization of sea transport adopted by the enemy. Let us assume that the enemy has adopted the convoy system. Roughly speaking, we may divide the operations of combatting sea transports into the following categories: in the home port, at sea, and at destination.

A most propitious period for a submarine attack is while the convoy is at sea. Thus, the submarines should be formed according to the task ahead, the number of submarines under command, their seaworthiness, crew combat training, submarine operational capability, geographical and hydrometeorological conditions of the war theater, etc. having considered these problems, one may establish the following convoy-fighting submarine formations: formation for destroying transports, formation against surface craft and convoy submarines, and reconnaissance and submarine-onto-convoy homing formation.

It should also be emphasized that when the convoy is forming or breaking up, the transports may be destroyed by single submarines.

Characteristics of a Submarine Attack Against a Convoy

A submarine attack against a convoy in the sector of its probable course may be either with or without homing. In the latter case, the submarines locate and attack with torpedoes independently. The telltale signs of an approaching convoy may be: periodic overhead passage of airplanes and helicopters at low altitudes and in various directions, systematic work of the radar stations of anti-submarine aircraft, continuous activity of the radio and radar stations of transports and convoy vessels, the singing of propellers of escorts and transports, and smoke on the horizon.

Submarines, after detecting a convoy, should approximate it and effect a torpedo attack in accordance with the demands of modern tactics.

Commanding Ships Used to Combat Convoys

In a limited naval theater there exist relatively good conditions for commanding submarines during operations. The most useful is the relaying of strategic information from land to a submarine operating in a given region. This is because the utilization of radio transmitters, active radar equipment, and hydrolocators by submarines may reveal the submarine formation.

When submarines receive location data from coastal command posts, they may detect the enemy faster and, therefore, effect a torpedo attack quicker than they would using their own technical observation equipment to find it. The speed of striking is very important because in a limited naval theater distances are small and the enemy may quickly pass the danger zone. In such a case, the tactical command should be in the hands of a commander on one of the submarines. This is dictated by the fact that in modern war operations at sea, command from land is unable to follow the fast changing pattern of war.

CONCLUSIONS

1. Fast technological progress in modern armed forces has to a greater degree made them dependent on supplies. Rapidly changing conditions of war, fast troop transfer, and the usage of new weapons create a situation whereby the importance of a limited naval theater, as compared with World War II, has increased considerably.

2. The most effective means of combatting enemy sea communication lines in a limited naval theater, are in our opinion: submarines, small and fast surface craft, and mobile batteries of rocket artillery.

3. The utilization of modern weapons compels one to look for new methods of organizing sea transport.

4. Submarines as a naval weapon display great potentialities in fighting enemy communications, because they operate while hidden, independent of the weather, display great viability when exposed to mass destruction weapons, and do not require air cover.

5. Reconnaissance for submarines nad homing them onto targets should be effected from land, on the other hand, the tactical command should be by a commander based on the submarine.

In this article an attempt was made to depict the probable activity of submarines with torpedo armament, against enemy communication lines in a limited naval theater. Undoubtedly, this article does not exhaust completely the entire problem; moreover, it is not intended as a definitive solution. However, the presentation of the problems should give the readers an over-all awareness of the specific operations of submarines in an attempt to solve one of the many problems facing them in modern warfare.

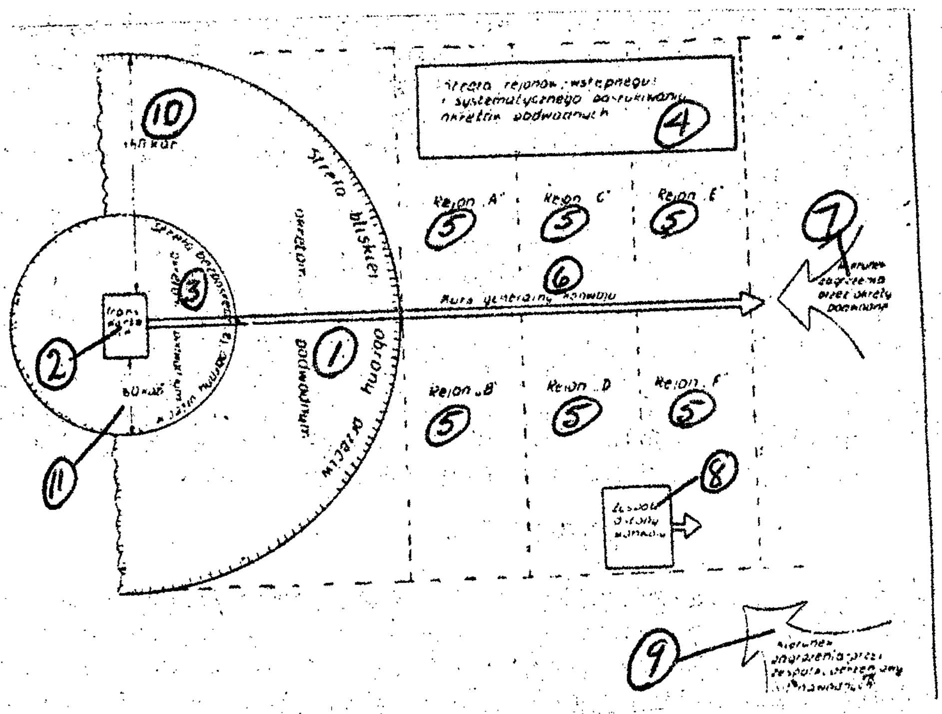

Diagram 1. Scheme of the Region
of Defense of a Convoy Against Submarines in a Limited Naval Theater

LEGEND: 1) Near anti-submarine defense region; 2) transport vessels; 3) Direct anti-submarine defense region; 4) Preliminary and systematic submarine searching region; 5) Region (a-f); 6) Rough convoy course; 7) Direction from which submarines attack; 8) Convoy protection squadron; 9) Direction of attack by squadron of surface vessels; 10) 150 cables lengths; 11) 60 cables lengths.

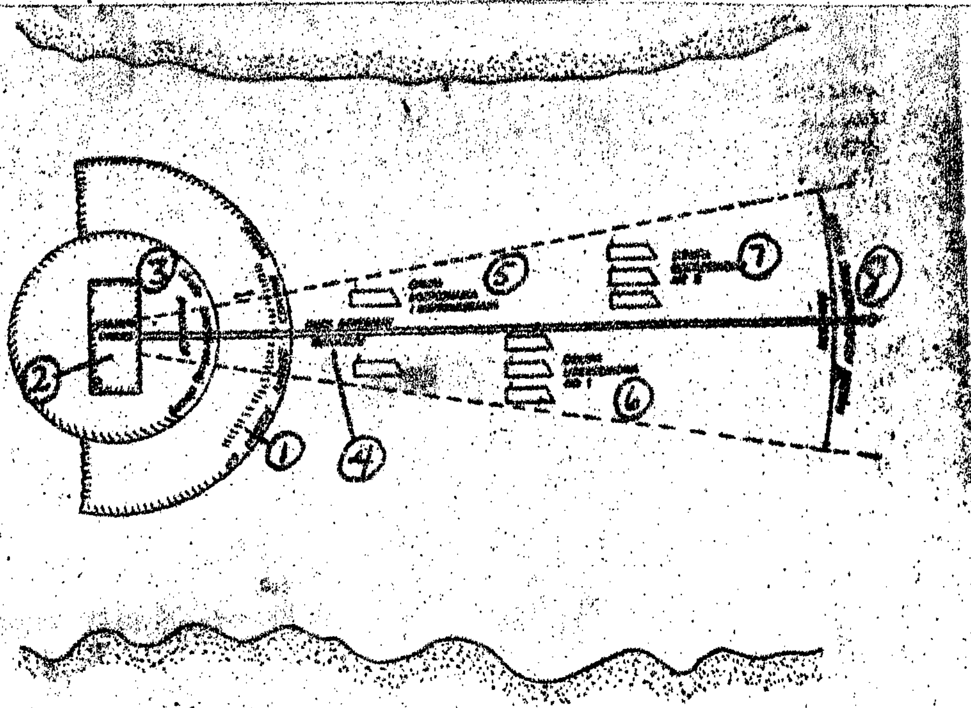

Diagram 2. Formation of Small Groups of Submarines in Sector of Probable Convoy Courses

LEGEND: 1) Near anti-submarine defense region; 2) Transport vessels; 3) Direct anti-submarine defense region; 4) Rough convoy course; 5) Reconnaissance and directing group; 6) First striking group; 7) Second striking group; 8) Sector of likely convoy course.

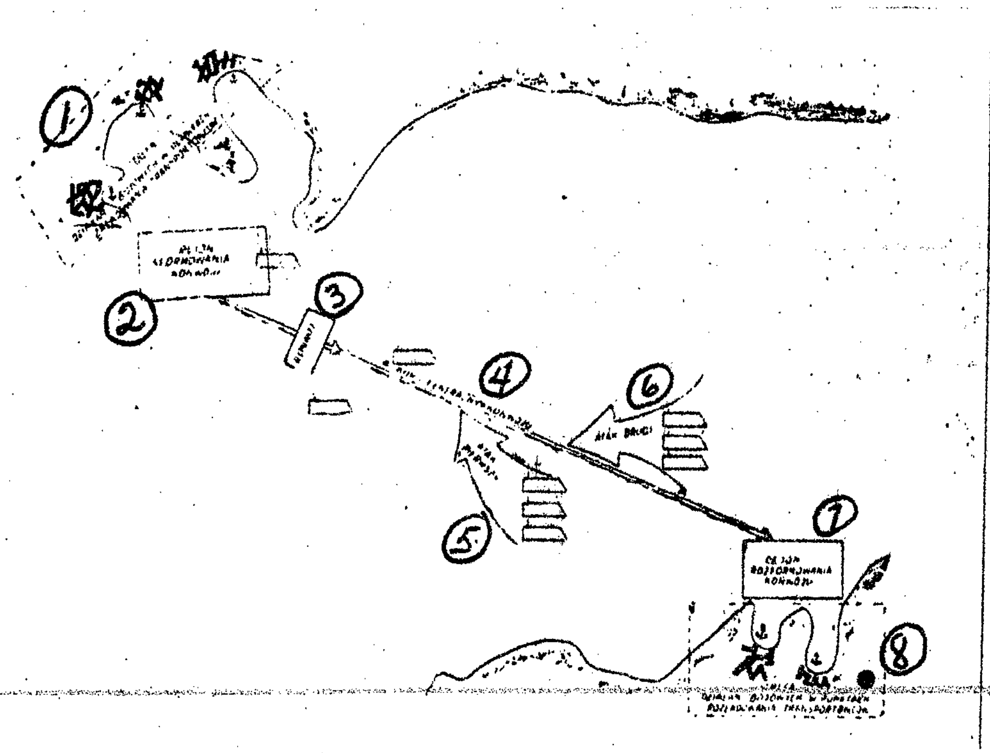

Diagram 3. Scheme of Torpedo Attacks Against a Convoy

LEGEND: 1) Combat OP in region of convoy loading; 2) Convoy forms here; 3) Convoy; 4) Rough direction of convoy; 5) First attack; 6) Second attack; 7) Convoy dissolving; 8) Combat OP in unloading zone.

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UTILIZING ARTIFICIAL EARTH SATELLITES FOR NAVIGATIONAL PURPOSES

[Following is the translation of an unsigned article in Przeglad Morski (Naval Review), Vol 14, No 3, Gdynia, March 1961, pages 23-37.]

In sea navigation, three artificial earth satellites may be used: one with a polar orbit, whose orbital plane passes through the poles; one with an equatorial orbit, whose orbital plane is identical with the equarotial plane; and one which has an intermediate orbit, whose orbital plane lies between the first two.

In order to use these satellites to fix the position of a ship at sea or a plane in the air, it is necessary to know the position coordinates of the satellites at every moment of observation. In determining those coordinates it is necessary to know the influence of the forces which affect the direction and speed of flight of the artificial satellite.

In general, these forces act on the satellite: a force depending on the variations of the gravitational field of the earth, the anomolies of the gravitational force, the gravitational forces of the moon and sun, and the resistance to motion of the upper layers of the atmosphere. The accuracy of calculations of its ephemerides [see Note] depends on the accuracy with which we know the influence of those forces on the flight of the satellite.

([Note:] Running coordinates of the satellite: (α) elevation; (δ) declination; and (h) height above the astronomical horizon.)

The theory of the orbit of the earth satellite has been worked out and enables one to perform the above-mentioned calculations. In order to obtain a result to a degree of accuracy sufficiently good for sea and air navigation purposes, it is important to know the corrections arising out of the forces influencing the flight of the satellite. This, however, is a complicated problem and shall not be discussed in this article.

For sea navigation it is best to use a satellite with a two-hour polar orbit, as in this orbit the upper atmospheric layers offer a smaller resistance than is the case with satellites whose orbit is shorter in time. Furthermore, the polar orbital plane has no motion

relative to the stars, due to external geophysical factors which considerably facilitates preliminary calculations.

For purposes of sea navigation it is necessary to place in orbit three artificial earth satellites at eight-hour intervals in order to ensure a 60° angle between orbital planes. If the satellites are equipped with radio transmitters, then by the ship's radio equipment its position may be determined anywhere relative to two satellites not less frequently than every two hours.

The methods which use the satellites to determine the ship's position are based on the determination of the satellite coordinates relative to the observer. As the satellite travels fast, it is more important to know exactly the time of observation.

Let us examine the table of average flight speed of a satellite following a polar orbit in the celestial sphere and the required accuracy of time determination.

Table 1. Average Flight Speed of a Polar-Orbit Satellite

1 Wysokość orbity w km	2 Okres obiegu w min.	3 Średnia prędkość kątowa na orbicie w °/sek.	4 Czas lotu po sferze niebieskiej obserwatora w min.	5 Średnia prędkość kątowa lotu po sferze niebieskiej w min. łuku/sek.	6 Konieczna dokładność określenia czasu w sek.
410	95	0,063	10,7	16,8	0,006
1000	105	0,057	17,6	10,2	0,009
1940	124	0,048	27,6	6,5	0,015
3500	158	0,038	34,3	5,2	0,019
6400	237	0,025	79,5	2,3	0,043
12250	417	0,014	162,0	1,1	0,091
30400	1160	0,005	516,0	0,35	0,285
35800	1440	0,004	651,0	0,28	0,357

Note: The calculations were made for a circular orbit relative to an average height and period of executing one orbit. The height [above the horizon], declination, and elevation of the satellite should be determined with an accuracy of o.1'.

LEGEND: 1) Orbit altitude in kilometers; 2) Time of one orbit, in minutes; 3) Mean angular velocity, deg/sec; 4) Flight time along observers celestial sphere, in minutes; 5) Mean flight angular velocity on celestial sphere, minutes of arc/sec; and 6) Necessary accuracy of time determination, seconds.

[In figures above, read commas as decimal points.]

It can be seen from Table 1 that the coordinates of a satellite with a two-hour orbit may be obtained with an accuracy of o.1', if the time on the orbit shall be measured with an accuracy not less than 0.01. Therefore, the ship should have accurate time-measuring devices, such as quartz clocks, and the observations should be automatically registered on a chronograph coupled to a quartz clock.

The accuracy of the position lines obtained from observing an artificial satellite shall depend on the method of observation.

To measure the height of the satellite above the horizon by means of traditional instruments and equipment is unacceptable, as the satellite moves fast in the sky and its height changes very quickly, consequently, even a small error shall substantially affect the final result. In addition, as the height and azimuth change quickly, the observation of the satellite by means of optical instruments is dif- ficult, even if it should have the brightness of a star of first mag- nitude.

It is fair to assume that to observe a satellite from a ship one would use a photoastrometric method, a radio distance system, and a method of utilizing the Doppler effect.

Photoastrometric Method for Determining a Ship's Position

This method is based on the determination of the position of the satellite through a trigonometric rel tionship with respect to stars in whose vicinity its actual position is projected. To this end we take a picture of the part of the sky against which the satellite is moving. At the time of exposure special machinery (a quartz clock) notes the time very accurately (see Table 1).

The photograph also contains the artificial satellite, as the camera used detects stars of the order of sixth magnitude and the sat- ellite appears as a bright staf of the first or second magnitude.

The photoastrometric method enables one to obtain two position lines from one observation of the satellite, thus yielding the coor- dinates of the observer's position.

Let us examine this method in more detail.

Let us assume that at a time T an observer is on earth at point a (Diagram 1), and the satellite is at point Sa. Point b is the pro- jection of the satellite onto the surface of the earth. The coordinates of the real projection of the zenith of the satellite onto the surface of the earth -- i.e., of point b -- one may determine in the following manner:

$$\varphi_b = \delta_{sa};\ \lambda_b = t_{grV} + \alpha_{sa};\ H = r - \rho,$$

where: δ_{sa} -- satellite declination

α_{sa} -- satellite elevation

t_{grV} -- the hour angle of Baran point (S_{gr})

H -- vertical distance between point b and the satellite

r -- distance from the earth's center to the satellite orbit

ρ -- the radius of the earth, assuming it to be a sphere.

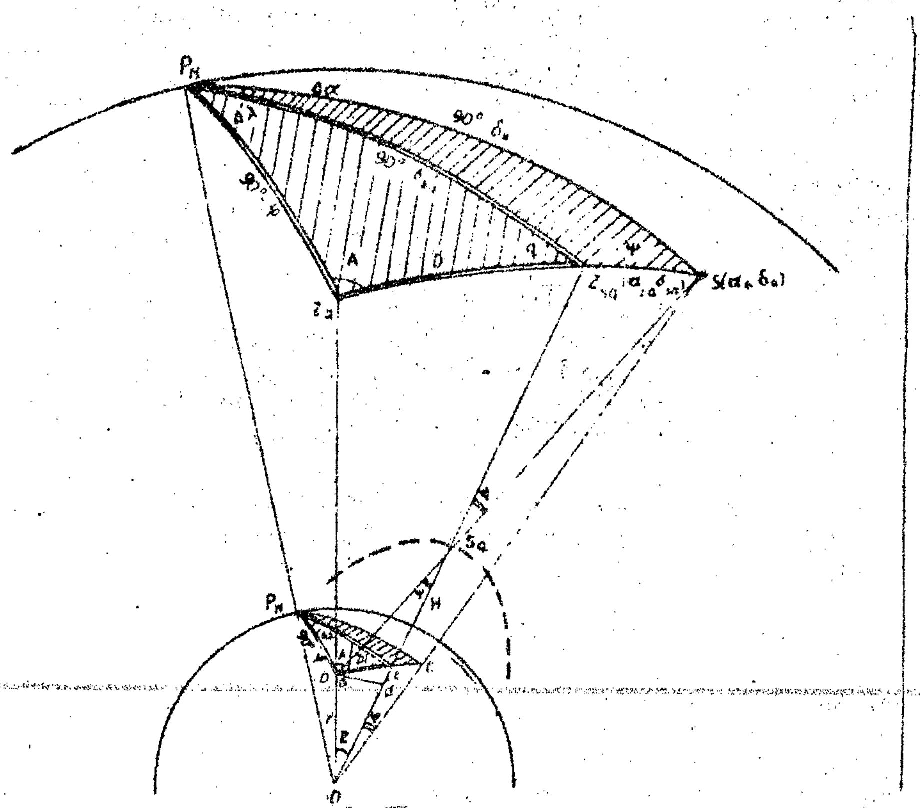

Diagram 1.

As the observer on earth is not at point b, but at a, he shall see the satellite not in his own zenith, but in the direction aSaS.

If we take a fix of the satellite (on the photograph) with a few neighboring stars, then we shall obtain it coordinates α and δ very accurately. These are the observed coordinates, i.e., the coordinates which the observer observes at the given moment (triangle Z_aP_nS). The actual coordinates of the satellite may be calculated from the triangle $P_nZ_{sa}S$. If, after having evaluated δ and α, observed and real, and we shall compare them with one another, we shall obtain an angular value for an arc SZ_{sa} equal to the angle ψ.

This arc shall determine the difference between the observed position of the satellite on the celestial sphere (S) and the actual position of its zenith (Z_{sa}).

Bearing in mind the fact that the distances to the stars are very large in comparison with the distance of the satellite from us, we may assume without introducing error that the angle bOC equals the angle $Z_{sa}S_aS = \psi$. As the result of introducing this assumption, the magnitude of the arc $Z_{sa}S$ may be found from the spherical triangle $P_nZ_{sa}S$ by the known cosine formula:

$$\cos Z_{sa}S = \cos(90 - \delta_*)\cos(90 - \delta_{sa}) + \sin(90 - \delta_*)$$

$$\sin(90 - \delta_{sa}) \cdot \cos \Delta\alpha$$

whence

$$\cos Z_{sa}S = \sin\delta_* \sin\delta_{sa} + \cos\delta_* \cos\delta_{sa} \cdot \cos\Delta\alpha$$

where

$$\Delta\alpha = \alpha_* - \alpha_{sa}$$

The calculations above have enabled the determination of the angle Ψ, which is required to calculate the first position line.

In the right triangle aSad the angle aSad subtended at the satellite is Ψ as it is equal to the angle $Z_{sa}SaS$.

If we are able to solve the triangle aSad, then we shall obtain on earth the distance between the observer and the projection of the zenith point b onto the surface of the earth. Call this distance D.

$$D = H \cdot \tan\Psi$$

As is seen from the formula above, D has not been calculated from the triangle aSab. Such a simplification may be made only for small D, i.e., when the observer at a is near to point b, as the triangle aSab in the approximation is also a right triangle and the magnitude of the arc ab is equal to the line segment ad. The above condition is satisfied when the line segment db is close to zero.

The calculated distance $D = H \tan\Psi$ is the first position line. If we fix the point b on the sphere and with it as the center describe a cirlce of radius D, the point a would be found on the circumference which then would be the first position line.

The above method suffers from the limitation imposed on it by the distance D and the magnitude of the angle Ψ. For large values of Ψ (it may reach $50°$) this method is inaccurate and should be abandoned. In such cases we shall calculate the zenith distance of the satellite (Z).

Let us consider the right triangles Saad and aOd.

In these triangles

$$od = dSa \tan\Psi = Od \tan Z$$

$$ad = (H + H') \tan\Psi = (\rho - H') \tan Z,$$

where $H' = db$.

The magnitude of H' we shall find from the corrected observer coordinates. cor = corrected

$$H' = \rho - od$$

$$od = \rho \cos Z_{cor}$$

$$H' = \rho - \rho \cos Z_{cor}$$

$$H' = \rho(1 - \cos Z_{cor})$$

Z_{cor} we shall obtain by applying the cosine formula.

$$\cos Z_{cor} = \cos(90 - \varphi_{cor})\cos(90 - \delta_{sa}) + \sin(90 - \varphi_{cor})$$
$$\sin(90 - \delta_{sa}) \cos \Delta\lambda_{cor}$$

$$\Delta\lambda_{cor} = \lambda_b - \lambda_{cor}$$

Finally we obtain the magnitude of the interval ad.

$$ad = (H + H')\tan \Psi = (\rho - h') \tan Z$$

From this formula we calculate Z.

$$\operatorname{Tan} Z = \frac{H + H'}{\rho - H'} \tan \Psi.$$

In this manner we have obtained the zenithal distance of the satellite, i.e., the distance between the observer's zenith and the zenith of the satellite for all values of Ψ.

The second position line is azimuthal and is obtained from the calculation of the spherical triangle $Z_{sa}P_nS$ by means of the angle q, and not from an observation from on board ship, as up till now there is no instrument which measures the direction to bodies above the horizon.

$$\frac{\sin(180^\circ - q)}{\sin \Delta\alpha} = \frac{\sin(90^\circ - \delta_*)}{\sin \Psi}$$

$$\sin q = \frac{\sin \Delta\alpha \cos \delta_*}{\sin \Psi}; \quad \sin q = \sin \Delta\alpha \cos \delta_* \operatorname{cosec} \Psi$$

Knowing the angle q and the zenithal distance $Z_aZ_{sa} = D$, ffom the spherical triangle $Z_{sa}P_nZ_a$ we may find the actual coordinates of the observer on earth.

$$\cos(90^\circ - \varphi_a) = \cos(90^\circ - \delta_{sa}) \cos D + \sin(90^\circ - \delta_{sa})$$
$$\sin D \cdot \cos q$$

$$\sin \varphi_a = \sin \delta_{sa} \cos D + \cos \delta_{sa} \sin D \cdot \cos q$$

In this manner we obtained the observer's latitude φ_a.

The longitude of point a we may calcualte from the triangle $P_nZ_aZ_{sa}$.

$$\sin \Delta\lambda = \frac{\sin D \cdot \sin q}{\cos \varphi_a}$$

$$\sin \Delta\lambda = \sin D \cdot \sin q \cdot \sec \varphi_a$$

When the formula $\tan Z = \frac{(h + H')\tan}{\varrho - H}$ is differentiated, we shall find out that even under most favorable conditions, the accuracy of determination of position for navigation purposes is sifficient.

<u>Determination of a Ship's Position by Determining Its Distance from the Satellite by Means of Radio Waves</u>

This method is based on the principle of distance determination, by radio technical means, between the satellite and the observer.

When the satellite travels through the observable portion of the sky, its distance from the observer is measured several times along a straight line between them. These distances are deonoted by D_1, D_2, and D_3 on Diagram 2.

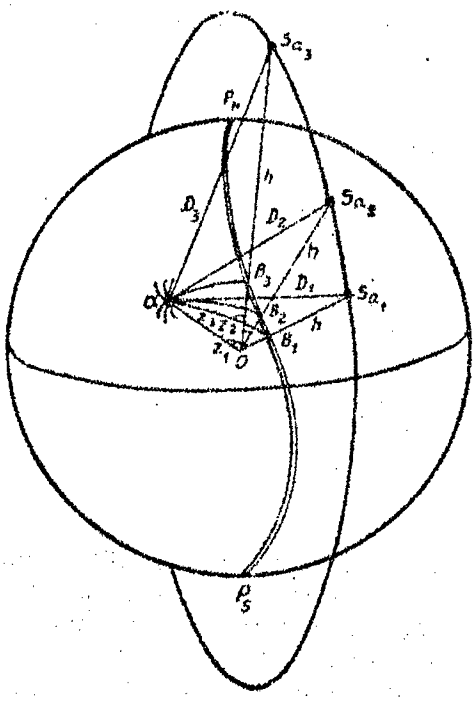

Diagram 2

The observer's position is denoted by a and the center of the earth by O. The points b_1, b_2, and b_3 arethe projections of the respective positions of the satellite onto the earth's surface; the ang angles Z_1, Z_2, and Z_3 are contained between the radius of the earth to the observer from the center and the straight lines between the center of the earth and the respective positions of the satellite.

To angles Z_1, Z_2, and Z_3 correspond arcs ab_1, ab_2, and ab_3 which are on the surface of the earth. The angles Z_1, Z_2, and Z_3 are the zenithal distances of the satellite at positions Sa_1, Sa_2, and Sa_3, respectively. The position of the observer is found by the following method:

1) Determine the distances D_1, D_2, and D_3.

2) The exact times of measurements t_1, t_2, and t_3 are recorded.

3) We determine the position of points b_1, b_2, and b_3, which are the zenithal projections of the satellite positions at times t_1, t_2 and t_3 from the available satellite coordinates δ_{sa} and α_{sa} from the ephemerides for those times.

4) Knowing the radius (r) of the satellite orbit, we are able to solve the triangles $OaSa_1$, $OaSa_2$ and $OaSa_3$, thus obtaining the zenithal distances Z_1, Z_2 and Z_3.

Using the generalized Pythagoras theorem we have the angle Z_1 from the triangle $OaSa_1$: $D_1^2 = \varrho^2 + r^2 - 2\varrho r \cos Z$.

In order to obtain $\cos Z_1$ the above equation is transformed as follows:

$$D_1^2 - \varrho^2 - r^2 = -2\varrho r \cos Z_1$$

$$2\varrho r \cos Z_1 = r^2 + \varrho^2 - D_1^2$$

$$\cos Z_1 = \frac{r^2}{2\varrho r} + \frac{\varrho^2}{2\varrho r} - \frac{D_1^2}{2\varrho r}$$

Hence

$$\cos Z_1 = \frac{r}{2\varrho} + \frac{\varrho}{2r} - \frac{D_1^2}{2\varrho r}$$

$$\cos Z_2 = \frac{r}{2\varrho} + \frac{\varrho}{2r} - \frac{D_2^2}{2\varrho r}$$

$$\cos Z_3 = \frac{r}{2\varrho} + \frac{\varrho}{2r} - \frac{D_3^2}{2\varrho r}$$

If we assume the earth to be a sphere of radius $\varrho = 6371$ km, and the satellite orbit was a circular arc during and between observations, then the first two expressions on the right hand side of the formula are constants which may be determined previously.

Solving, we have the zenithal distances Z_1, Z_2 and Z_3 expressed in angle units. These are the observed zenithal distances. Wishing to determine the position of the observer, we need know the corrected zenithal distances and azimuths for those observations.

The corrected zen thal distances and azimuths are obtained by solving the triangles aP_nb_1, aP_nb_2 and aP_nb_3 using the cosine formulas. In these formulas we use the corrected latitudes and longitudes of the observer (Diagram 3).

$$\left.\begin{aligned}\cos Z_{z11} &= \sin \varphi_{z1} \sin \delta_{sa1} + \cos \varphi_{z1} \cos \delta_{sa1} \cos \Delta\lambda_{z11}\\ \cos Z_{z12} &= \sin \varphi_{z1} \sin \delta_{sa2} + \cos \varphi_{z1} \cos \delta_{sa2} \cos \Delta\lambda_{z12}\\ \cos Z_{z13} &= \sin \varphi_{z1} \sin \delta_{sa3} + \cos \varphi_{z1} \cos \delta_{sa3} \cos \Delta\lambda_{z13}\end{aligned}\right\}$$

NOTE: <u>z1</u> above = cor (corrected)

The azimuths shall be calculated from the sine formulas:

$$\left.\begin{aligned}\frac{\sin Az_1}{\sin \Delta\lambda_{z11}} &= \frac{\sin (90^\circ - \delta_{sa1})}{\sin Z_{z11}}\\ \sin Az_1 &= \frac{\cos \delta_{sa1} \sin \Delta\lambda_{z11}}{\sin Z_{z11}}\\ \sin Az_1 &= \cos \delta_{sa1} \sin \Delta\lambda_{z11} \operatorname{cosec} Z_{z11}\\ \sin Az_2 &= \cos \delta_{sa2} \sin \Delta\lambda_{z12} \operatorname{cosec} Z_{z12}\\ \sin Az_3 &= \cos \delta_{sa3} \sin \Delta\lambda_{z13} \operatorname{cosec} Z_{z13}\end{aligned}\right\}$$

Where

$$\left.\begin{aligned}\Delta\lambda_{z11} &= \lambda_{b1} - \lambda_{z1}\\ \Delta\lambda_{z12} &= \lambda_{b2} - \lambda_{z1}\\ \Delta\lambda_{z13} &= \lambda_{b3} - \lambda_{z1}\end{aligned}\right\}$$

Afterwards the method is similar to the determination of an astronomical position line by the height method. On a map or on a sheet of paper we set off an approximate position and draw the azimuths. On them we set off the calculated intervals $\Delta Z_1 = Z_{cor} - Z_1$; $\Delta Z_2 = Z_{cor} - Z_2$; $\Delta Z_3 = Z_{cor} - Z_3$. Here we adopt the following convention: if Z_{cor} is greater than the given Z, then the correction ΔZ is positive and we set it off on the azimuth, from the corrected position towards the satellite; if the correction ΔZ is negative, i.e., $Z_{cor} < Z$, then we show it on the azimuth of the corrected position away from the satellite. At the end of each ΔZ we draw a position line which is perpendicular to the azimuth. The intersection of all positions lines gives the observed (true) position of the ship.

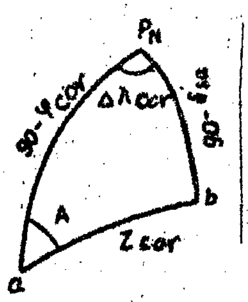

Diagram 3

One should pay attention to the sign of the azimuth obtained from the sine formula, as it depends on the respective quadrant. The method of assigning a sign to the azimuth is treated in detail in every textbook on nautical astronomy.

The method described above, using artificial earth satellites for the determination of a ship's position, is both convenient and rapid. Its advantage is the rapidly changing azimuth, which enables one to obtain two mutually

intesecting position lines at a sufficiently large angle (30^{o}), within a short period of time.

The accuracy of this method depends on the elevation above the horizon of the observed satellite. For elevations close to 90^{o} (when Z tends to zero) the position should ot be determined, as in this case large errors are made in estimating the zenithal distance. It is best to observe the satellite just after its dawn and immediately before its setting. For fairly large elevations, even, the accuracy of measurement is satisfactory. For example, let $h = 50^{o}$ and ΔD = 300 m the distance error, then the zenithal distance error is $\Delta Z = 11'' \approx 0.2'$, which is equivalent to two cable lengths.

Determination of the Position Line Using the Doppler Effect

This method requires that the artifical satellite have a continuously working radio transmitter.

As the flight velocity of the satellite is high, the frequency of radio waves emitted by it shall apparently change by a magnitude $\frac{V \cos\alpha}{\lambda}$, which we call the Doppler frequency.

The Doppler frequency depends on the speed of flight of the satellite — V, and the angle α, contained between the direction of flight of the satellite and the azimuth line from the observer to the satellite and the wave length of radiation λ.

When V and λ are kept constant, the only variable is α, hence the Doppler frequency varies as cos α.

When the satellite is approaching the observer head-on, its Doppler frequency is positive and changes from a maximum to zero, when the satellite is directly above the observer and the instantaneous change of distance is nil, ($\cos\alpha = 0$) and the Doppler frequency is zero. When the satellite moves away from the observer, the Doppler frequency is negative and decreases from zero to an algebraic minimum. Thus we see that the Doppler frequency varies as the cosine of α.

If the ship contains an instrument which enables it to observe the Doppler frequency and to determine accurately the instant when it is zero, then one is able to obtain a position line. It will be a circular arc of a great cirlce, which passes through the point at which the satellite was while at zenith with respect to the observer. This arc is in a plane perpendicular to a plane determined by the velocity vector of the satellite while at that zenith point (Diagram 4).

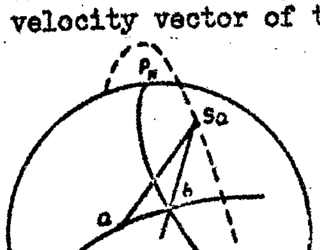

Diagram 4

The direction of flight of the satellite and its coordinates should be prepared beforehand, the latter with an accuracy of the order of a minute of arc.

If the instant of time at which the Doppler frequency is zero is determined with an accuracy to 0.01 sec, then the position of the zenith of the satellite

is obtained with an accuracy of 0.29'. The accuracy of obtained position line decreases as the observer moves away from under the zenith point of the satellite and as the zenith distance increases.

The combination of the Doppler frequency variation method and the radio method of distance measurement enables one to determine one's position, even if the satellite soars directly through the zenith of the observer.

Use of Satellites with an Intermediate Orbit

The path of flight of a satellite relative to the surface of the earth varies depending on the angle, the orbital plane of the satellite with the earth's equatorial plane. As this angle decreases the satellite may be observed from a progressively smaller area. From the flight path of the first Soviet artificial satellite (Diagram 5), which had its orbital plane inclined to the equatorial plane at an angle of 65°, it is seen that its path of flight relative to the surface of the earth is a complicated curve, and that it was impossible to observe it in the polar regions. Despite that, the portion of the globe in which a satellite with such an inclination of its orbital plane may be used for sea navigation is large in comparison with US satellites, which could be observed only within small areas about the equator.

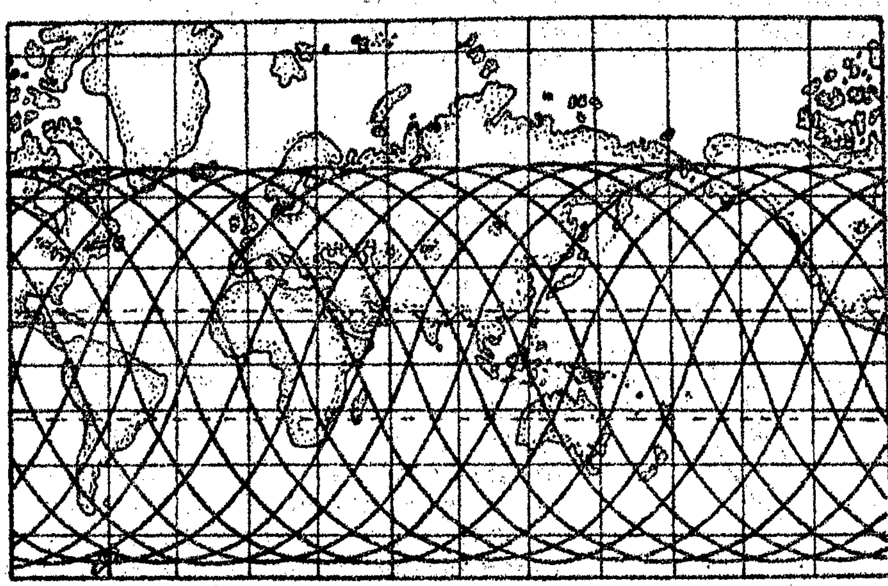

Diagram 5

The calculation of coordinates of a satellite whose orbit is an intermediate one is more complex than it is for satellites with polar or equatorial orbital planes. This is because one has to consider large forces, which are difficult to calculate, which change

the given intermediate orbit.

Observation methods and computations of ships' positions at sea by means of satellites with intermediate orbits are the same as for satellites with a polar orbit.

Use of Satellites with Constant Orbits

Among satellites with an equatorial orbit, special attention is merited (from the point of view of navigation) by a satellite with a so-called constant orbit, whose height above the surface of the earth is 35,810 km, and whose period for one orbit is equal to the perdd of one revolution of the earth about its axis. Such a satellite shall be stationary relative to the surface of the earth, hence its coordinates on the celestial sphere and its projection onto the earth's surface shall be accurately known, which shall considerably simplify the determination of a ship's position.

Constant-orbit satellites may be used as stations for interplanetary flights and to create a world-wide television and communications system. The relevant data of constant-orbit satellites are set forth in table 2. In order to ensure that at least one satellite should be seen from any point on earth (with the exception of the polar regions), one has to have at least three satellites n the constant orbit (Diagram 6).

The position of a ship at sea or a plane in the air may be determined by observing the stationary artificial satellites of the earth, using a method of Somner or by measuring observer-satellite distances by radio.

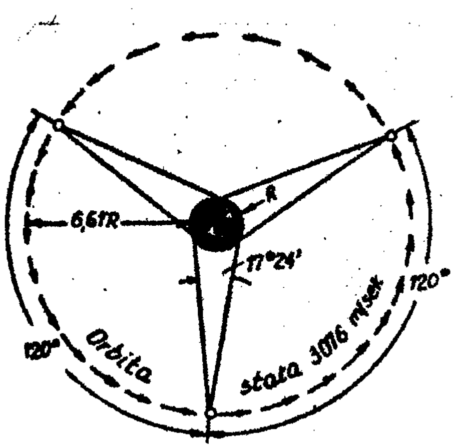

Diagram 6

Use of Stationary Satellites for the Determination of a Ship's Position by Astronomical Method

Generally speaking, one may state that the determination of position on earth by the astronomical method is, in essence, equivalent to the determination of the true zenith for the observer on the celestial sphere. It is known that for every position of the observer on earth there exists a unique zenith on the celestial sphere. The astronomical position determination may be arrived at by the determination of the zenith coordinates on the celestial sphere, as the projection of the zenith point onto the surface of the earth is the true position of the ship on it.

Heretofore, the astronomical zenith position was defined relative to the stars, planets, or the sun. Having artifical satellites

Table 2. Characteristic Data of a Constant-Orbit Satellite

Period of orbit with respect to the sun	$24^h\ 00^m\ 00^s$
Period of orbit with respect to the celestial sphere (sidereal period)	$23^h\ 45^m\ 04^s$
Distance from the center of the earth	42,188 km
Height above the equator	35,810 km
Cruising speed	3076 m/sec
Length of equatorial arc from which the satellite may be observed (angle)	162°36'30"
" " " " " (arc)	18,102 km
Equatorial arc length from which any two out of three equally spaced satellites may be seen	14,232 km
Ratio of the arc to the equator (percent)	26.21%

has created the possibility of determining the zenith point in the celestial sphere relative to one particular satellite. This method is based on a known astronomical elevation method.

Let us assume that the observer is on earth at point a, and his zenith on the celestial sphere is at Z_a. The stationary artificial satellite is at Sa (Diagram 7).

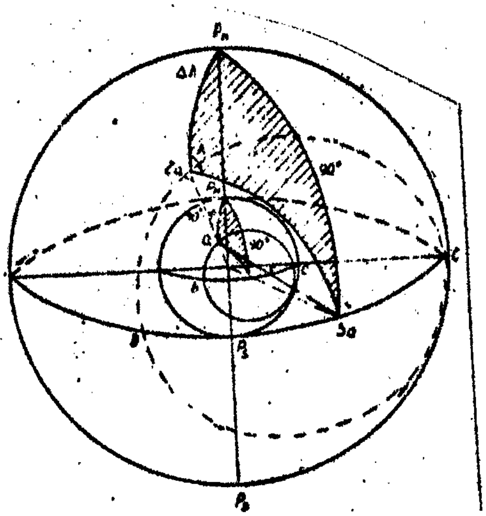

Diagram 7

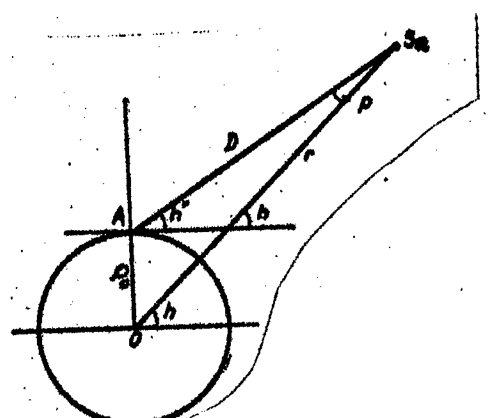

Diagram 8

It is known that the arc Z_aSa on the celestial sphere is the zenithal distance of the satellite. One may construct a circle of equal zenithal distances, that is, equal elevations, by projecting the position of the satellite onto the surface of the earth and with

this point as the center, to describe a circle of a radius equal to the measured zenithal distance Z. If an arbitrary number of observers were positioned on the circumference of that circle, each one would measure th a sextant the same elevation of the satellite, i.e., the same zenithal distance Z. This circle is thus the locus of points which are equidistant to the zenithal projection of the satellite, thus being a position line.

As was mentioned before, the zenithal distance is obtained by measuring the elevation of the satellite above the horizon. As the distance of the satellite from the earth is very small in comparison with the distance from the earth to the stars, when determining elevation, there is a large parallax (Diagram 8).

The zenithal distance Z is found from the formula

$$Z = 90^{o} - h$$

where h is the geocentric elevation of the satellite (i.e., measured from the center of theearth).

It is evident from Diagram 8 that the true elevation (geocentric) is the sum of the measured elevation (topocentric) and a parallax correction.

$$h = h'' + p$$

where p is the horizontal parallax.

In order to calculate the parallax for an arbitrary observation, let us use the horizontal parallax, which is the largest of all parallaxes for a given satellite and is for the case when the satellite is in the horizon of the observer.

The parallax is calculated drom the triangle ASaO.

$$\frac{\sin p}{\sin (90^{o} + h)} = \frac{\rho_o}{r} \Rightarrow \sin p = \frac{\rho_o}{r} \cos h''$$

where o is the average radius of the earth.
r is the distance between the center of the earth and the satellite.

Let us calculate the parallax for the case of the satellite being in the horizon, and having an orbit of 35,810 km away from the earth's surface; the satellite being stationary relative to the earth. (In the problem we assume the mean value of ρ_o).

$$\sin p = \frac{\rho_o}{r} \cos h''$$

Because $h'' = 0$, then $\cos h'' = 1$, and

$$\sin p = \frac{\rho_o}{r} = \frac{6371}{42{,}188} = 0.662 = 41.4^{o}$$

This example shows how large the parallax may become.

When the artificial satellite passes through the zenith of the observer, then the parallax vanishes as $\cos h'' = \cos 90^\circ = 0$.

As the parallax must be known exactly, the mean value of ϱ_o may not be used in the parallax formula, but the true value of the radius of the earth ϱ at the position of the observer. The true radius of the earth does not remain constant, as the earth is not a sphere, but an ellipsoid of revolution.

The accurate value of the radius of the earth, for the observer, is found from the formula

$$\varrho = a\,(1 - \alpha \sin^2 \varphi)$$

where φ is the corrected latitude of the observer,
a is the equator radius = 6378.388 km,
α — the flattening of the earth = 1/297

We substitute the true length of radius ϱ in the parallax formula.

$$\sin p = \frac{a}{r}\,(1 - \alpha \sin^2 \varphi)\cos h''$$

The magnitude $a/r = \sin p_o$ is called the equatorial horizontal parallax. The final parallax formula is

$$\sin p = \sin p_o\,(1 - \alpha \sin^2 \varphi)\cos h''$$

Using this formula we may construct a parallax table for various conditions.

Having evaluated exactly the parallax we add it (as it is always positive) to the measured elevation h'', thus obtaining the true (geocentric) satellite elevation (h_o).

The value of the true zenithal distance is obtained from the formula

$$Z_o = 90^\circ - h_o$$

Knowing Z_o one may determine the ship's position by means of the elevation method, i.e., by determining the values of Az and ΔZ.

$$\Delta Z = Z_{cor} - Z.$$

$$\cos Z_{cor} = \cos \varphi_{cor} \cos \Delta\lambda_{cor}$$

We neglect the second half of the right hand side of the formula, as the declination of a stationary satellite is always zero ($\sin 0^\circ = 0$)

We compute the azimuth from the triangle $P_n Z_a Sa$ using the sine formula.

$$\sin Az = \sin \Delta\lambda_{cor} \sec h_{cor}$$

From the corrected position we draw the azimuth and set off on it the value ΔZ similarly as when using Δh.

The second position line we obtain from observing the second

stationary satellite.

Stationary artificial satellites of the earth are especially suited for observations if they have radio transmitters. Using a radio-sextant and converters, the ship will continuously and atuomatically receive its coordinates φ and λ.

Determining a Ship's Position by Measuring the Distance from It to a Stationary Earth Satellite

For a known elevation (h) of the satellite above the surface of the earth, the equatorial radius (a) and distance (D) from the center of the earth to the corrected position of the observer (ϱ), when the distance between the observer and t satellite is determined by radio system, from the triangle ASaO (Diagram 9) thus determined we may find the true zenithal distance of the satellite. Here we use the generalized Pythagoras theorem.

$$\cos Z_o = \frac{r}{2\varrho} + \frac{\varrho}{2r} - \frac{D^2}{2r\varrho}$$

from the triangle $Z_a P_n Sa$ (Diagram 7) we ~~calculate the corrected zenithal dis-~~ tance Z_{cor}.

$$Z_{cor} = \cos \varphi_{cor} \cos \Delta \gamma_{cor}$$

Knowing Z_o and Z_{cor} we form their difference.

$$Z = Z_{cor} - Z_o$$

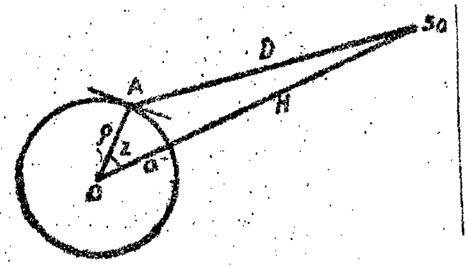

Diagram 9

This difference, depending on its sign, we set off on the azimuth from the corrected position, towards or away from the satellite, and draw the position line.

This method is fairly accurate, especially when the satellite is being observed just above the horizon.

Example. Let h = 9°, and the error in the distance measurement of D is 300 m; the zenithal distance difference error is ΔZ = 0.2', which is two cable lengths.

When the satellite is close to zenith, no measurements should be taken, as ΔZ is large.

An analysis of feasible systems in which stationary satellites of the earth are used to determine the ship's position tells us that in the case where the measurement of the elevation of the satellite with a satisfactory degree of accuracy may not be made, then the required accuracy may be ensured by the distance measurement by radio means. Knowing the areas navigated and the time of observations, one may, beforehand, select the most accurate method of observations.

As has been mentioned above, a stationary satellite shall

remain stationary relative to an observer on the surface of the earth. As the distance between them is large, the special position of the satellite relative to the observer shall change but slowly when the latter changes his position. This is especially true in intermediate and high latitudes and is only dependent on the speed of motion and the latitude of the position of the observer. Stationary satellites of the earth may also be used to determine true directions.

The problems discussed in this article enable one to draw the following conclusions:

1. When artificial satellites of the earth with polar or intermediate orbits are used to serve sea navigation, the photoastrometric method proves the most accurate one. In order to use this method, one needs a cloudless sky and a sufficiently well illuminated satellite.

A determination of the exact position of a ship by the distance method by radio techniques and by using the Doppler frequency is independent from the time of dat, visibility, and the weather.

2. When stationary satellites are used, most accurate results are obtained by the elevation and distance methods.

3. As experimental data are gathered from which one may be able to determine the influence of the forces affecting satellite orbits, the method of calculating the astronomical coordinates of the satellites shall be perfected, which, in turn, shall increase the accuracy of obtained observations. Thus it is reasonable to assume the development and rapid perfection of new methods of determination of a ship's position at sea and a plane in the air anywhere on earth.

10,092
CSO: 1759/2

YUGOSLAVIA

ARMY, TECHNOLOGY, AND ECONOMICS IN YUGOSLAVIA

[Following is the translation of an unsigned article in TESIA, Vol VIII, No 1, Belgrade, January 1961, page 52.]

Following is an interview with the head of the Administration for Military-Technological Research of the Yugoslav National Army on the contributions of Army scientific research institutes to our economy.

At the beginning of the interview General Potpukovnik Vlado Matetic told our correspondent that the development in some branches of science and technology towards the close of World War II had attained such dimensions as to alter concepts of warfare in their very fundamentals. Advances in nuclear science, rocketry, electronics, and in other military technologies, have had a revolutionary effect on the tactics and strategy of all armies. The scientific research of our Army is, of course, directed primarily at the specific requirements of contemporary armament and the equipment of our military units. It is conducted in accord with the development of our war industry, the economic growth of our country and its material potentials. However, though the immediate problems of military-technological research relate to armament and the construction of defense measures, the character and spirit which pervade our army are such that it also takes upon itself problems which refer to the requirements of our economy and wider consumption in general.

The General stated that he would mention only a few randomly selected examples to show the relationship of Army research to our economy.

It is well-known how hard we are working today on the introduction of automation. Its basis are electronics. It is particularly in this field that the contributions of the experts of the military institutes have been most significant. The Army, for instance, is devoting much attention to the advancement of the technology of transistors. It began with the study of the so-called diodes, simple thermo-electronic detectors, continuing with the investigation of the German "tackast" diodes, devices for the regulation of alternating currents in various electronic appliances, instruments of telecommunication, radio-television, radar, etc.

After the Military-Technological Institute had achieved during 1958-59 semi-industrial production of these elements which are irreplaceable in modern industry, there has recently been carried out a transfer of their documentation and manufacturing procedure to the R.R. institutes in Nis, where their serial production is already in process. The above work represents, however, only the first phase in the mastery of the production of component parts of circuits. The head of the Administration for Military-Technological Research stated that our next task, among others, is the complete mastery of the manufacture of low and high frequency transistors.

General Potpukovnik Vlado Matetic pointed out a few more aspects of the endeavors to master the technology of transistors. Experts of the Military-Technological Institute have achieved full mastery of the technology of miniature regulators of tension from network, the so-called German regulating diodes. Their documentation and their completed process of production have also been handed over the R.R. institutes in Nis, which have completed preparations for their serial manufacture in 1960. Parallel to this, the Institute was conducting studies on the so-called printed circuits. The industrial process of manufacture of printed conductors and elements of circuits was worked out in cooperation with experts of the manufacturing concern "Telekomun-lkacije" of Ljubljana, which will soon begin their serial production.

In cooperation with the Industry for Electric Conductors (Industrije za elektroveze) of Ljubljana, the serial production of condensers with dieletrics of thin foil of "polistrirol" was achieved during the period 1958-59. They are the most modern invention for the conservation of electrical energy and through their relatively simple technological processes of manufacture are solved the complex problems of the production of coiled condensers for electronic devices and instruments of telecommunication.

General Potpukovnik Vlado Matetic thus claimed that the contributions of the institutes and laboratories for scientific research of the Yugoslav National Army to the development of our electronics, the basis of automation, are of great importance. He added that the readers would no doubt also be interested in other fields of scientific research of the Army and cited, as an example, the manufacture of silicon. These are compounds of silicium and certain organic groups, which are obtained in the form of oils and greases. Today we possess a factory for silicon, the "Prva iskva" in Baric, the semi-industrial construction of the plant having been made by Army specialists. The latter had been conducting intensive research in the field of silicon during the past few years in cooperation with chemists of Belgrade University. Our consumers will soon have the opportunity to become acquainted with this material and its unique properties, its low susceptibility to the effects of temperature, humidity, water, etc. It will be applied to clothing textiles for protection against moisture and to the facades of houses; it will be used for the manufacture of a wide variety of rubber objects required in industry, medicine, housing, etc. The production of silicon will be of great economy to us.

Scientific research in the field of civil engineering performed within the framework of the Yugoslav National Army has also yielded significant results. The Army has, for example, built suspension bridges over the Moraca and Drina rivers. They are light, elegant, aluminium structures possessing large spans and great carrying capacity. It is not necessary to stress the significance of these bridges for our country, especially for her mountainous areas and regions intersected by rivers.

Thus far, these bridges represent the most effective, and least expensive, solution to these important problems of mountain communication.

Not only civil engineering, but agriculture too, has received considerable help from our Army in the form of so-called mobile workshops. These workshops, lodged in one or more vehicles, are equipped with a complete set of instruments and tools. On large agricultural tracts and building sites they can repair and help maintain machinery of all types.

Mobile workshops, the theoretical solution for which had been worked out by co-workers of the Military-Technological Institute, are already in serial production at the Industry for Tractors and Machines (Industrije traktova; mashina) in Zemun. They will also find application outside our country.

Toward the end of his exposition General Potpukovnik Vlado Matetic acquainted our correspondent with numerous technological solutions which had been created by the coworkers of the Military-Technological Institute and adopted by our industry. Mention was made of the manufacture of dry cell batteries, made possible by Army experts working in conjunction with specialists from the "Munja" factory, in Zagreb; the construction of motorized sprayers for disinfection and extermination of insects, designed for use in institutions for hygiene and in agriculture (manufacturing plant FAMOS) and a number of similar instances. General Vlado Matetic, head of the Administration for Military-Technological Research of the Yugoslav National Army, concluded his remarks with the statement that, if the completion of the first five-year plan for economic development of capital construction had created favorable conditions for intensive scientific research in the Army, the Army's scientific work is certain to be of yet greater significance to our economy during the completion of the second five-year plan. The people may expect a great deal from this project of the Army, and the Army shall continuously live up to their expectations.

10,189
CSO: 1831-S

POSITION, ROLE AND MISSION OF THE MIDDLE-LEVEL MEDICAL CADRE IN MODERN ABC WARFARE

/Following is the translation of an article by Sanitetski Porucnik Radovan Jovic in Sanitetski Technicar, No 5, Belgrade, Sept-Oct, 1960, pages 405-423./

"War techniques today have reached such a degree of development that atomic weapons are considered as the dominant weapon of an eventual future war. The production of atomic weapons is now such that they have already become 'the law of the community' in many contemporary armies. The rule book of tactics has been adjusted due to them and a reorganization of all aspects of fire power is taking place both in countries which possess atomic weapons and those which do not. On the basis of the supposition, and independent of it, that atomic weapons will be the main weapon of an eventual future war, the systematic preparation of civilians for self-protection and for the complete mobilization of all power for waging a war is being carried out."

General potpukovnik Dr. Gojko Nikolis: "General Problems of the Medical Service in War," (The Medical Worker in Defense of the Country), Zdravstveni radnik u obrani zemlje, 1960.

In the world today there is much said and written about the dangers and aftermaths of an eventual future ABC war and little about the possibilities of protection and the weaknesses of this destructive weapon. It is written up in the daily press in such a manner that the ordinary citizen receives the impression that this is a catastrophe which is impossible to live through. Incorrect information is often given in this manner which is exaggerated and unfounded. It serves and has served as propaganda for the large powers to whom such actions are convenient. However, even though there may be many truths in these headlines, the problem of protection must be viewed in another manner. If it is known that atomic weapons have such a large destructive effect and that they can cause a catastrophe, it is also necessary to know similarly the weaknesses of these weapons and on the basis of this to reach a conclusion as to whether or not there is the possibility of protection and survival.

The fact is known that an ABC war carries not only large destruction and annihilation of personnel and materiel but also a misconception about the catastrophic annihilation of mankind which arises

from the conviction that there exists no protection. On the contrary, the notions of total downfall of a people are unfounded, because considering the problem realistically, protection is possible:

"If in the physiognomy of a future war, all the relativities and weaknesses of atomic weapons are seen;

"If the defender selects such tactics and strategy that paralyze the tactics and strategy of those who possess atomic weapons or will not allow the attacker to deal a crushing blow to the defender;

"If a nation in due time prepares for such tactics, if it takes hold and will be prepared to carry on, if it will be armed with the united desire to defend" (General potpukóvnik Dr. G. Nikolis).

On the basis of what has been presented here, it is possible to conclude:

a. That the great powers have at their disposal a mass of atomic, biological and chemical weapons, weapons for the mass annihilation of personnel and materiel. This huge war potential is increased day by day and in addition there appear new nations which succeed in producing atomic weapons (the French with their atomic bomb tests in the Sahara).

b. That nuclear and thermonuclear weapons have unusually high destructive effect and many after-effects on manpower and material.

c. That because of all this we must be prepared to defend ourselves in the event of such an ABC war.

This is the place for us to speak about the part that we of the middle medical cadre have in the preparations for defense (and about our role) in any future ABC war. It means that we must be prepared to defend our homeland, making the maximum effort in general battle.

The question now stands before us: what is this ABC warfare?

1. Atomic warfare (A) entails the use of atomic weapons to annihilate personnel and materials. These weapons are classified into atomic explosive devices and combat radioactive substances, the latter derived as a byproduct in the form of radioactive dust used in the same manner as war gas, from an airplane, in a bomb, or otherwise. Atomic explosive devices are classified according to how they release energy into nuclear, thermonuclear and three-phased explosive devises. The method of launching that may be used includes aerial bombs, atomic artillery shells, mines, atomic warheads on missiles, atomic torpedos, fougasse, and others.

The characteristics of these weapons are covered in the following:

They have unusually great destructive power on manpower and materiel. Their power depends on the size of the bomb. The size of a bomb and its strength are almost unlimited. While an atomic bomb, due to critical mass, must be limited in size, a hydrogen bomb, for which an atomic bomb serves as a detonator, has a huge size. Today hydrogen bombs are known to have the strength of up to twenty megatons (MT) (1 MT equals the effect of a 20-million-ton explosion

of TNT).

The targets for atomic and hydrogen bombs and other atomic weapons will most often be: communications networks, administrative centers, industrial plants, airfields, bases and warehouses, important tactical centers, command areas, concentrations of troops and people, etc.

Atomic weapons will be used successfully both in attack and defense.

Atomic weapons have an unusual morale -- psychological effect on the army and citizens, although this effect is relative, depending on the degree of protection and the level of the general morale of the army and citizens. The effect and use of atomic weapons depend upon the configuration and geological makeup of the ground, meteorological conditions (wind, rain, fog, visibility and others), and the strategy and tactics of the opposition.

Atomic weapons in an eventual future ABC war will readily be used in atomic warheads and for launching missiles.

The use of atomic weapons in war will not be absolute. That is, atomic weapons are not the only nor the absolute weapon of a future war. Atomic weapons are only the dominant weapons considering their superior strength over the others. They cannot achieve their complete effect without conventional weapons. Both types of weapons mutually supplement one another; therefore, a combination of both types of weapons will be used. Only atomic or only conventional weapons will be used in individual instances.

2. Biological warfare (B) entails the use of biological agents and their products for the military purpose of massive contamination of people, food, water, crops and ground. Biological warfare, more than other types of warfare, offers the enemy the possibility of using a weapon which will not be easily discovered by the existing methods of identification.

The means of biological warfare would be: special types of bacteria cultivated and prepared for this purpose, or their toxins (most often the causes of infectious diseases); various types of known and yet unknown viruses; various types of fungi and their toxins; and rodents and various insects.

The use of these means may be: by diversified methods, indirectly by agents in the enemy's rear area or directly by means of spraying biological agents from special apparatus from airplanes, which will appear as a fine aerosol spray dispersing in the air bacteria, viruses and toxins. There is talk also about the possibility of dropping rodent pests on crops of the attacked country. They would very rapidly destroy the crops and in that manner the inhabitants would face starvation and the attacker would be able to capture the country with complete preservation of the industrial potential.

It is not possible to say for certain whether the use of biological means for the massive annihilation of personnel will come in an ABC war. However, we must be prepared for defense against such an attack because the use of these weapons is a possibility.

3. Chemical warfare (C). The use of chemical means for military purposes is not new. It is known that people started using chemical means from the times of the Greco-Roman wars until the Geneva Ban. But despite this ban, it is necessary to state here that the use of chemical weapons in an eventual future war is a possibility.

Modern military gases, at least those which are known, are also a means of vast annihilation. The most toxic among them are the so-called trio. They are phosphine oxides discovered by German researchers. Because of the manner in which they act, Western scientists have given them the group name, nerve gases. The best known among them are: tabun, sarin, soman, diphenal phosphate, armin, and others. But, in addition to these for military purposes, it is possible to find wide uses for some of the classical gases such as Yperite, lewisite and others. All of these gases have great toxicity and instantaneous affect on man. Under way are very active investigations in the area of protection of discovery of new means.

If to these means are also added the means of conventional armament, in addition to the use of aviation and missiles, the picture is clear that all this is preparation for a future war, for the annihilation of personnel and materiel and for occupation of a country.

On the basis of all that has been said up to now, it is possible to expect that a future war will have the following characteristics:

1. It will be total with regards to area, i.e., it will be conducted with equal intensity simultaneously throughout the entire territory of a country. The front will be everywhere.

2. The entire population will be included in the war. The whole nation will fight until exhausted.

3. All material resources will be used in the war. All medical cadres will be utilized to care for the civilians and the military.

What problems will an ABC war cause for the medical corps?

This question is a very difficult one to answer, considering that there is almost no experience to draw from. All conclusions must be based on the published work of American, Soviet, Japanese and other scientists who have described the catastrophes at Nagasaki and Hiroshima. In addition to this we will, as in future practice, rely upon the experience acquired in our NOR (Narodnooslobodilacki Rat - National Liberation War) and during World War II in general.

The most important problems which would confront medical personnel in an ABC war would be: the large number of losses; the lack of material resources; the peril to medical institutions and personnel; the lack of cadres; and work under unfavorable conditions.

I. The Characteristics of the Casualties

The characteristics of the casualties we understand to be:

1. There will be a vast number of casualties. Future ABC war

will result in a great many more casualties than all previous wars. The number of these casualties will depend not only on the effectiveness of the ABC weapons, but also to an equal degree upon the tactics employed by the defender, the training of military and civilians, the geographic and topographic contours of the ground, the preparedness of the civilians to take cover in air raid shelters and natural shelters, to dress one another's wounds, and to give themselves first aid. But even under the supposition that all of the above conditions are favorably resolved in time of peace and continuously carried out in time of war, systematically and in an organized manner, the fact still remains that casualties will be far greater than in all previous wars.

2. They will appear almost instantaneously. It is certainly not necessary here to explain any further, since it is clear that if one atomic bomb explodes on a populated or partly populated area, casualties will appear instantaneously, i.e., immediately with the explosion of the bomb which occurs in a thousandth of a second.

3. They will appear simultaneously in various areas. The enemy will probably endeavor to attack simultaneously the front and the rear areas in order to create a much larger center of destruction.

4. Of the entire number of casualties about 50 percent will be burns. This is one of the new phenomena which an eventual future war will bring -- rarity since in previous wars burns were only an insignificant percentage. Thus these injuries, which will appear in the greatest number in an atomic war, deserve special attention.

Burns will appear as the result of the primary and also the secondary action of the atomic bomb. This means that we will have burns caused by the primary action, the flash of the atomic explosion, and burns resulting from the secondary fires caused by the explosion of the atomic bomb in the blast area within the appropriate distances from ground zero.

For this phenomenon to be clearer, we must remind ourselves of the three basic effects of an atomic bomb explosion: blast, heat and radioactivity. Here we have the result of the heat effect of the atomic bomb. It is important to say that this effect is the most characteristic and causes the greatest percentage of injuries to people and livestock.

The results of the three effects on people are considered to result in the following percentages:

1. Heat causes 50 percent of all injuries.
2. Blast causes 25 percent of all injuries.
3. Radioactivity causes 25 percent of all injuries.

Not only does the heat effect cause a massive number of burns, but these burns are most often combined with other blast injuries, since the epicenter and the corresponding circle around ground zero experiences a complete combustion of all organic material (depending upon the strength of the bomb and the heighth at which it explodes).

5. New types of injuries exist:

a. Radiation burns;

b. Contamination of wounds and wound dressings by radioactive material; and

c. Acute radiation sickness.

These are the three basic new types of injuries and illnesses which a possible future war will cause, although there are still many which have not been examined and singled out as personal problems.

These injuries result from the third effect of the atomic bomb, radioactivity. It is known that every atomic bomb explosion is followed by the emission of nuclear radiation. This nuclear radiation, according to its duration and affect, is classified as:

Primary or initial radioactive radiation; and

Secondary or subsequent radiation.

Primary radioactive radiation occurs at the moment of the explosion of a nuclear projectile and its duration is very short. Secondary radiation results from radioactive fallout.

Radiation burns are injuries of the skin caused by the effect of alpha and beta particles striking the skin. However they have a weak penetrating strength on undamaged surfaces of the body, but they are dangerous if they enter the organism by means of food and water.

The contamination of wounds with radioactive dust will cause an extra danger to the life of a man, because the absorption of radioactive material will be much quicker and bandages will be useless against infection.

Acute radiation sickness causes a whole series of symptoms which are the result of the effect of ionizing radiation if a person is exposed to a sufficient amount of this radiation.

The threshold of sensitivity of the human organism is considered to be a dose of 150-200 roentgens, resulting in the mildest form of this sickness thus far found.

Up to the present there are known and described three stages of radiation sickness:

Hematological, which occurs from a dose of 150-400 roentgens, with changes to the blood producing organs: leukemia, purpura, hemorrhaging, infection and high temperatures.

Death due to this form of radiation sickness, if treatment is not undertaken within sufficient time, will occur after two months. This form of radiation sickness is the most studied up to date. Our atomic scientists from Vinca were suffering from this form of radioactive sickness when the reactor was damaged. They were successfully cured.

The gastro-intestinal form occurs from a dose of 500-1,000 roentgens and causes pathological changes in the gastro-intestinal tract. The clinical signs: diarrhea, vomiting, temperature and disorder to the circulation of fluids and salts. Death usually occurs after two or three weeks.

The cerebral form is the most difficult. It occurs when a person receives 1,500-2,000 roentgens. The signs of the sickness are: convulsions, tremors and other symptoms of disorders of the central nervous system. Death occurs very quickly, within two days. This form has been least tested because experimental animals which might receive such a large dose of radiation would die before all the symptoms of the sickness could be successfully observed. Prognosis of this form of sickness is extremely bad.

When we speak about the casualties in a possible future ABC war, we usually take as an estimate the examples of casualties at Nagasaki and Hiroshima, where the attack was made with atomic nominal bombs of 20 kilotons. Therefore, we will use these estimates here in order to give at least an approximate picture of what types and how many casualties occur in an atomic attack.

From the attack with a 20-KT atomic bomb on the Japanese city of Hiroshima there were 80,000 dead and missing and 40,000 wounded (from the civilian and military population of the city). If we estimate these casualties by the square kilometer of populated area, then we derive that in Hiroshima there were 13,000 casualties per square kilometer.

The second example refers to the bombing of the Japanese city of Nagasaki with the same sort of 20-KT bomb. This city was a little more densely populated and the casualties were greater. According to estimates it has been established that Nagasaki had 18,000 casualties per square kilometer.

From this directly follows the question of how the problem of caring for such a number and such types of casualties will be solved and of what kind and how large will be the role of the middle medical cadre in these affairs.

First of all it is necessary to reconcile oneself to the fact that in a future war there will be a disporportion between the available forces and means on the one hand and the number of casualties which must be cared for on the other.

This statement establishes the following estimates: "If we take for example that after an atomic attack we have 10,000 wounded, approximately 5,000 of them will be burns. Caring for only these 5,000 burns will necessitate: 300,000 large bandages, 75,000 small bandages, 525,000 meters of gauze, 9,000 kg. of cotton, about 8,000 liters of colloidal solutions (blood, plasma, dextrose, and others), about 25,000 liters of the physiological solution of NaCl, about 35,000 billion units of penicillin and about 35 kg. of streptomycin." Generalmajor Dr. Izidor Papo: "Battle Surgery Today," Zdravstreni radnik u odbrani zemlje, 1960.

Further, in order to care for 10,000 wounded it would be necessary to have about 650 surgical teams and, if we assume that along side of each surgeon-doctor team work at least two central medical workers (each surgical team has at least two surgeons), then about 2,600 of these specialists would be necessary.

An increase in the number of cadres and materials cannot adequately meet the increase in the number of wounded. Therefore the problem of caring for the wounded will only be solved by good organization which must be adapted to the demands of contemporary warfare. This organization must be such that it ensures the realization of the aim of the medical service, which is to offer the greatest amount of aid to the greatest number of injured in time and thus, return them in greater number to fighting condition.

For this aim to be realized and the organization to be set up properly, it will be necessary to arrange a revision and modification of all basic traditional methods of the medical evacuation care of the wounded under battle conditions. The greatest changes will be in the methods of classification and the principles of treatment of the wounded.

We shall consider here separately each of these tasks of medical-evacuation care of the wounded: classification, treatment, and evacuation.

Classification

The concept of classification we understand to mean the group of methods for classifying the wounded into categories according to the speed of medical attention needed.

Classification of the wounded, when there are a great many, has always been one of the basic principles of surgery and the primary step against chaos both in war and peace, when there are various natural calamities (earthquakes, fires, floods, crashes).

In a future atomic war classification will be considered the key to medical aid, which will allow a way out of this unforeseen situation of accommodating a mass of wounded.

But, classification is by no means a novelty. It has been carried out thus far in all wars and on all occasions when within a short time there appeared a large number of wounded. In these instances all the wounded cannot receive help at the same time; it is necessary to classify them according to the type of injury and diagnosis of treatment, degree of speed, extent and form of aid, and stage of medical-evacuation care needed.

In contemporary war and the appearance of a mass of wounded for whom the medical service must care, the criteria of classification must be changed so that it corresponds to the basic aim -- saving manpower. Saving the life of an individual is subject to the conditions and interests of saving the nation, they will show that it will be indispensible for the medical service to be relieved of those categories of wounded which can be returned to service since they warrant elementary general medical attention.

The surgical service, when time is of the essence, will have to be relieved of still another category of wounded: those whose diagnosis is very bad and whose surgical care demands long operations. Such operations would take so much time and material that in the same amount of time surgical help could be given to a far greater number of those wounded for whom small surgical attention

(for example tying off a large blood vessel) would save their lives with good prospects for complete recovery.

Therefore, today it is considered that in a future ABC war all the wounded will be classified according to a unique set of criteria into four categories:

1. The first category includes the lightly wounded who require a minimum of attention to enable them to return to action. These wounded will be able to return to their duty after appropriate self-aid or mutual aid in the majority of cases, while only a small number will receive first aid from a nurse or elementary medical aid from a central medical worker.

Included here are: contusions, lacerations, uncomplicated fractures of small bones (higher extremities), burns covering ten percent of the body, and other minor wounds. It is expected that this group will include about 40% of all the wounded.

2. The second category of wounded are those who require minor surgical treatment. This includes the following types of wounds: external bleeding, wounds bleeding or not requiring light dressing, traumatic amputation and amputation under shock and without it, open fractures of small bones and joints, open pneumothorax, compressive pneumothorax, mechanical asphyxiation, and others along these lines.

As is apparent, these are wounded for whom surgical attention, if given in time, will save their lives or capabilities. This group, of course, must receive first or general aid from nurses or middle medical workers before getting surgical attention.

It is expected that this category will include about 20% of all cases.

3. The third category of wounded includes those whose surgical attention may be postponed. After they receive elementary medical aid, they can without great risk be evacuated to territorial institutions where they will receive the necessary surgical attention.

In this category are the following types of wounds: open or closed fractures of large bones and joints, penetrating wounds of the chest with hematothorax, second and third degree burns covering 10-40% of the body and similar cases. It is thought these wounds will comprise about 20% of all cases.

4. The fourth category includes the group who are waiting for surgical treatment. They receive elementary medical aid which prolongs their lives so that it will be possible for them to receive surgical treatment.

This group will receive that first aid, elementary medical aid, and surgery which is possible. This group includes the following types of wounds: critical penetrating wounds of the head, chest and abdomen; critical combination and related wounds; critical related and multiple wounds on the body; burns which cover more than 40% of the body; etc. It is assumed that 20% of the wounds will be of this nature.

In advance of the presented problem of classification we must

reach conclusions as to what role and tasks will be set before the central medical cadre in this area.

Will classification be executed by the middle medical cadre? It is not possible to give an exact answer to this question. This is because it still has not been established as to who will execute this classification in the event of an ABC war. There exist two completely opposite opinions: one feels that classification can be carried out exclusively by surgical specialists, while the other feels that it can be carried out by each nurse.

It is assumed that the truth lies somewhere in the middle, which means that classification will be carried out by general practitioners or middle medical workers under their control, or independently. Therefore the middle medical cadre must be prepared and equipped to execute this classification in the event of a future ABC war.

For the middle medical cadre to be prepared to carry out such an important task in the event of war, it must in peacetime have command of a minimum in this field, which will be based upon the following facts:

1. Classification is based on the primary principles of relieving the doctors of 40% of the wounded whose care will fit within the framework of self and mutual aid, or that only 40-60% of the wounded be surgically treated (during past wars 80%) and in this manner the problems of cadres, materials and time will be alleviated.

2. For this very reason the responsibility of the people who execute the classification is obviously huge.

3. It is necessary to endure until the end on the accepted principles of classification. They must be realized completely in action without regards to various types of opposition.

4. It is self explanatory that these criteria hold only for exceptionally difficult situations, i.e. when it is necessary to care for a huge number of wounded directly after an atomic attack.

The principles of classification which have been given will have their own principle value in future war in general, since in such a war not only atomic weapons will be used. This means that in an individual sense, where conventional weapons will be used, conventional principles of classification will be used.

<u>Treatment</u>

"The initial fact governing the entire extent of medical aid in war is: it is impossible in an atomic war to give the type of medical aid to a huge mass of wounded as was given during World War II" (General potpukovnik Dr. Gojko Nikolis).

In such a situation there exists only one form of relief: through classification free the doctors of a large number of wounded (about 40%), but there still remains the large problem of how to render aid to the remaining wounded.

In order to make the medical service responsible for such a task it is necessary to revise the extent and form of aid, which has changed so much that instead of first, pre-medical, medical,

surgical and specialist aid, there will exist in a present-day war three basic forms of aid:

a) First aid, which will be seen in self and mutual aid given by the citizens and the soldiers to themselves and their neighbors. Only as an exception will this type of aid be given by nurses. This type of aid will include 40% of the wounded. This includes: bringing the wounded in, putting them up for the night, hemostatics, primary dressing of the wounds, cleaning the wounded, artificial respiration, giving atropine and others.

b) Elementary or general medical aid, which will be given by the middle medical cadre under the control of doctors. This form can include 60% of all the wounded. This includes: decontamination, hemostatics, reviving, feeding the wounded, infusion, transfusion, stomach pumping, fighting infection, fighting shock, and others.

c) Surgical aid, which will be given by surgeons and other doctors under the control of surgeons. It is estimated that about 40% of the wounded will receive this type of aid. These are the wounded who require surgical treatment.

The extent of the aid must be narrowed down to the degree of how the greatest number of wounded can receive at least the minimum amount of aid. Minimum aid includes precisely the three forms of aid mentioned above.

But even here we cannot be allowed to take the principle of the minimum amount of aid to the greatest number of wounded as a permanent practice. No, the extent and form of aid will be given in that manner only under conditions of caring for a mass of wounded directly after an atomic attack. However, the variability of the extent of the aid will depend upon:

The specific situation at the front and in the rear areas;

The available number of specialized personnel;

The adaptable and available amount of medical material and equipment in a given situation; and

The ability of the medical workers, and many other conditions.

At the end of this chapter it is necessary to discover the tasks and role of the middle medical cadre in treating the wounded under the described circumstances.

From what has been discussed, it is not difficult to conclude:

1. The middle medical cadre will have a very significant role and a responsible task in caring for and treating the greatest number of the wounded. As has been mentioned, the elementary medical aid which will be rendered by the middle medical cadre under the control of doctors, will be given to the second, third and fourth categories of wounded, or 60% of the entire number of casualties.

2. Elementary or general medical aid includes pre-medical and medical aid which is given earlier by doctors' aids or doctors. This means that this is one degree of greater aid which the middle medical cadre will now have to give. Because of this it is also necessary to assign the task of specialized improvement and permanent training to the middle medical worker so that he will be able

to be responsible for such tasks.

3. Due to the large number of wounded to whom the middle medical cadre will give help, there is still a greater need for training a large number of this cadre. This means that a qualitatively and quantitatively strong middle medical cadre is a necessity for the medical service for it to successfully carry out its tasks in a modern ABC war.

Evacuation

Rendering aid and evacuation are two inseparable tasks in the process of caring for the wounded in time of war. Due to the tactical situation a wounded man cannot receive all the aid in one area. He cannot receive it on the battlefield, because all the medical institutions cannot be accommodated there, while to be driven back to the rear line might endanger the life of the wounded man and then the most conscientious aid would be superfluous. Therefore, the one possible solution is movement from place to place where, depending on the wound and the disposition of medical institutions and specialists, the forms of aid will be prolonged so that by the end of this trip, the wounded man will have received aid and be returned to action.

However, atomic war causes a deep disorder in the balance between treatment and evacuation. This disorder is reflected in the following:

a) Under conditions of a mass number of wounded, which makes it impossible to evacuate them by motorized vehicles or when there is nowhere to evacuate them to, evacuation would be unthinkable. In such cases "treatment on the spot" will be the principle. Temporary classification centers and appropriate medical stations will be set up which will treat the wounded in the area.

b) The rapid development of operations dictates "evacuation at any price" at the cost of treatment. Evacuation will become the chief task, with the aim of saving the wounded and maintaining the morale of the fighters. Treatment will be narrowed to the absolute minimum. Hence preparing the wounded for transportation will be very important (perfect immobilization, analgesia, reviving and others) which all medical workers will participate in.

Moreover, the following possibilities for evacuating wounded come into consideration:

a) Through the center, this is the classical evacuation into the rear area which will be possible only when the front is stable and when there exists a rear area.

b) Flanking, or evacuation to the side, will be used when access to the rear area is impossible or when there is no rear area. Then the wounded will be evacuated to the enemy's rear area or to a territory which the enemy is not attacking.

c) Evacuation in a circle, this evacuation presents a maneuver with the wounded when the enemy takes over the clean territory on which the wounded were accommodated. In addition to providing the wounded with hidden shelter by this means, it is also possible to save them from the enemy.

The most important tasks of the middle medical cadre regarding the evacuation of the wounded would be:

1. Careful preparation of the wounded for transportation (keeping them warm, correct position, immobilization, Esmarch bandaging, and others) which will especially warrant much attention in contemporary warfare.

2. Nursing the wounded and rendering aid during transportation (taking care of the dressings, giving drink, warming, reviving).

3. Management of the medical transportation station and the evacuation section of the medical station.

4. Nursing the wounded and conservatively treating the fourth category of wounded at the collection areas and the medical stations.

II. The Lack of Materials

The example of the simultaneous treatment of 5,000 cases of burns clearly speaks for the necessarily large amount of medical material and it is possible to state that there is no country which would be able to supply such an abundance of material as would be necessary according to peacetime norms for a mass of casualties which would appear in the event of an ABC war. Accordingly, the problem of materials will have to be solved by utilizing in one way or the other the means at hand and by various improvisations.

Therefore it is necessary to train the middle medical cadre and the other medical specialists to adapt to the habit of working under conditions of the utmost scarcity and not to be depressed if they have to depart from the precious peacetime technique.

However, in peacetime they must prepare a considerable reserve of medical material and equipment which must correspond to the following conditions: they must be light; they must be universal; they must be elementary and in sufficient quantity; they must be simple so that they can be used by semi-qualified cadres or a non-technician; and they must correspond to the possibilities of production or of the economy.

The warehouses must be universal (in assortment), scattered and accessible to the wounded.

Finally it must be permanently kept in mind that a future war will be conducted under conditions of extreme shortage of medical and other materials. Not even the richest atomic country will be able to escape this shortage; much of their reserve material will be destroyed and they will have to depart from expensive and complicated medical techniques because these will be difficult to use in the dimensions of an eventual future war.

III. The Peril to Medical Institutions and Work Under the Most Difficult Conditions

It is a known fact that aggressors in previous wars did not adhere to and respect the Geneva Convention. During the Second World

War there were numerous examples of attacks by German soldiers on medical institutions and collection areas of wounded. They even captured medical workers (doctors and other medical personnel), they were shot as were other officers from operational groups. It is not conclusive that this inhuman action of an enemy will be more apparent in a future war. But even though the medical service will not be the aim of an enemy attack, the destructive effect of atomic weapons will destroy the majority of medical institutions and medical workers. This can be assumed, because the medic will no longer live and work in the secure rear area, protected by the operational actions of the soldiers at the front. The medic will live and work at the front because the front will be the entire territory of the country. Accordingly, in every instance the medical institutions and medical workers will be equally imperiled and can correctly expect to have many casualties.

This assumption is also established by the fact that in the Japanese city of Hiroshima during the attack with a 20-kt atomic bomb, out of 2,000 doctors, 90% were among the victims, and out of 43 hospitals, only three were usable.

Because of this, it is believed that the medical service will deploy its forces and materials in various forms of small acceptable stations in trenches and sheltered areas, using only a minimum part, and always have in reserve twice the amount of materials and cadre so that with the unexpected appearance of a large number of wounded from an atomic bomb attack they will be able to quickly set up on the spot. With these forces and materials they will form medical and surgical teams which will have the task in this imperiled area to classify, render direct aid, and quickly evacuate the wounded or else set up in the area acceptable medical stations and render the most complete aid possible in the given situation.

It is believed that a strong reserve with all its representative profiles of medical workers will be one of the most determining factors in caring for the greatest number of wounded in a present day war.

The basic qualities of the wartime medical service, civilian and military, must be: simplicity, mobility and presence in every area.

IV. The Problem of the Cadre

1. The Activity of the Cadre. As we have previously stated, it is foreseen that the cadres of the medical profession will render the following types of aid in a future ABC war:

a) Doctors, including specialists, will render surgical aid and exercise control and supervision over the central medical workers in this field.

b) The middle medical cadre and the mobilized nurses will render general medical and elementary medical aid.

c) All citizens and all nurses will render first, mutual and self aid.

This results in the middle medical cadres rendering elementary medical aid to 60% of all wounded, playing a major and decisive role in the medical aid in contemporary warfare. But in addition to this the activity of the middle medical cadres will be reflected also in the following:

They will have an important role in surgical aid as surgical assistants and other assistant jobs.

They will have the role of professional supervisor over the work of the nurses.

One part of the middle medical cadre will have the task, as in peacetime, of working in the organization and management of the organs of the medical service.

Similarly it is assumed that under the control of doctors they will classify the wounded and perform many other professional and organizational duties.

In one word, the activity of the middle medical worker will be many phased and the tasks will be large and responsible ones which all middle medical workers will consequently have to accomplish.

2. The Need for the Cadre. How large the need for a numerous and qualified cadre is seen from the previous discussion. The above analysis clearly indicates that the middle medical cadre will have to care for 60% of the wounded in a present day war. If the peacetime medical service is to work most successfully it must have at least two middle medical workers for every highly qualified one and at least one doctor per 1,000 inhabitants; then, this relationship must be increased still more in a present-day war. This sufficiently illustrates and indicates how large a middle medical cadre must be maintained and qualified during peacetime. It is clear that this quantity cannot be secured by normal schooling and therefore this difficiency must be compensated for by the simple training of the existing cadre and by transferring part of the task to the lower medical worker and training him. That this is possible is proved by the examples of our NOB (Narodnooslobodilacka borba - National Liberation War) when our partisan nurses, abandoning their shepherdess tasks, became such good medical workers that they must be given everyone's gratitude. They were taught in the open or in the forests. Therefore would it not be possible under peacetime conditions to train our lower medical cadre for the performance of such important tasks in a present day war?

Hence the number of the cadre trained can be doubled if the trained cadre through various courses and lectures imparts an elementary knowledge to other citizens.

3. The Training of the Cadre. Our middle medical cadre is trained according to the school programs and plans which are based on the corresponding tasks and roles in the medical service. Practice has shown that for the peacetime needs of the medical service the quality of this training of the middle medical cadre is

sufficient. However, the question presents itself as to how and in what manner is it necessary to continue the instruction of the entire middle medical cadre so that it will be better prepared for the defense of the country in the event of war.

It is understandable that in view of this eventuality, we are working out a systematic curriculum which will form a new special postgraduate course. This postgraduate training would prepare the medical cadres for executing a minimum medical standard for combat conditions.

"The program of the course on the minimum medical standards for combat conditions would include the following subjects for the middle medical cadre:

Organization of the medical service during wartime;

Organization of the care of a mass of wounded resulting from the bombing of the larger settlements and cities;

Lifting and transporting the wounded;

Classification of the wounded in a bombed city on the spot or at a first aid station;

The techniques of applying all types of bandages;

Stopping bleeding (digital compression, compressive bandages, Esmarch binding, placing tampons in the wound);

Transporting immobilizing stretchers of the most important types (Kramer, Diterix, Thomas, plaster, plaster casts, bandage, and means at hand);

First aid: burns, wounds caused by the shock waves of an explosion, wounds resulting in dislocations and breathing stoppage (suffocation, swallowing the tongue, drowning, poisoning, carbon monoxide poisoning, electrical shock, etc.), heat waves, sunstrokes;

Recognition of the signs of poisonous war gases and first aid;

Recognition of radioactive poisoning and the procedures with radiation;

Practical handling of equipment for radiological detection and measuring dosage;

Procedures with contaminated wounded and their decontamination;

Procedures with contaminated water, food and medical material;

Giving injections ("subcutaneous," intramuscular, intravenus);

Determination of blood type by smear;

Preservation and use of blood;

Giving blood, plasma, saline solution, and colloidals (dextran and others).

Giving oxygen;

Various methods of artificial respiration;

Application of stomach pumping;

Giving fluid by means of the stomach or rectum;

Characterization of the urinal bladder;

Undressing and cleansing of the wounded and ill;

Observing the condition of the wounded and measuring the pulse, temperature, breathing and blood pressure;

Measures for general patient care (washing the patient, keeping

him warm, changing his position, preventing bedsores, feeding the wounded);

Care of the mouth and procedure when there is vomiting;

Care of a patient in depressed condition;

Giving enemas;

Procedure with wounded or patients during transportation;

Taking and sending samples for laboratory and chemical analysis;

Chlorinating water;

Hygienic inspection of water facilities (wells, cisterns, small water supplies) the setting up of wells and cisterns;

Knowledge of the basic improvised equipment for conducting personal hygiene, disinfection, insectides, disposal of human excrement, disposal of waste (burning in stoves, cesspools), obtaining and purifying water;

The important methods of disinfecting and fighting insects and vermin under war conditions; and

Sterilization of the sanitary material necessary for the treatment of the wounded.

"The courses for the middle medical cadre must have a definite practical nature. They must conform to the organization and methods of education," (Colonel Dr. Svetislav Nesic: Sanitetska nastava i obuka /Medical Education and Training/.

As is apparent, a large number of these subjects have been learned by our middle medical workers in the middle medical schools and they are no novelty to them. However, demanded here from the middle medical workers is qualification for exact execution of certain technical jobs from the minimum medical standard under combat conditions. The intention of these courses is the permanent improvement of all work which the middle medical workers perform in practice, and by means of practical training to avoid the existence of amiddle medical worker who knows theoretically how to explain the genesis of the blood elements and the cycle of development, but does not know how to count erythrocytes or to stop bleeding because he has never done this.

Some subjects from the cited program of the minimum combat standard must be singled out because they are new to the majority of middle medical workers in the community. In general these are the subjects which include ABC protection, concerning which very little is taught in the middle medical schools or are generally not included in the program. This includes: first aid and treatment of burns caused by conventional and ABC weapons, recognition of the symptoms of acute radioactive poisoning and the procedure with those suffering from it, detection of war gases in water and food and the operation of detection equipment, procedures with wounded who are contaminated, radioactive dust and contamination of wounds, recognition of the signs of nerve-gas poisoning and the procedures thereafter, etc.

For this purpose it is necessary to engage teachers from this

area of activity to teach all these subjects. This must be organized through the society or through courses within the medical organization. It is even possible to have training on the days which the specialized society proclaims as their day of the year.

But in addition to this training it is necessary to think also about the ideological and political training and postgraduate education of our cadre. This is one of the very important tasks for shaping the form of the middle medical worker in the socialistic Fatherland. Therefore in meeting the war minimum for the middle medical cadre, subjects from this part of the postgraduate training, as from pedagogy, psychology and dialects, cannot be forgotten.

Within the area of work of the middle medical cadre in preparing for the defense of the country, there is also the task of teacher. That is, the middle medical cadre must engage in instructing the war minimum to nurses and citizens; must organize courses, lectures and seminars; or by means of action throughout our villages impart health and medical education to the citizens. Concern for the nurses must be the permanent concern of the middle medical worker and especially of the specialized union. The middle medical workers must instruct the nurses in rendering first aid, arranging transportation immobilization, extracting wounded from a demolished bombed city, selecting and transferring wounded in the primary decontamination of personnel, how to stop bleeding, and other urgent steps demanded by the wound or operation situation in contemporary warfare.

Similarly, it is the task of the middle medical worker to teach the citizens, especially of small villages, and middle school children how to render first aid with regards to self and mutual aid, how to stop bleeding, to know the regulations pertaining to the use of protective means (gas mask, etc.) during an ABC attack, how to execute primary decontamination, how to give themselves an injection of atropine if poisoned by nerve gas, and to prepare them psychologically.

From all that has been said it is clearly apparent that there stands before the specialized unions a very extensive and very important plan of preparation for all the members to defend the country. In other words, the mastery of the wartime minimum medical standard which will significantly result in training the middle medical cadre in the measures which will give them an up-to-date understanding of the role and place of the middle medical service under the conditions of contemporary war.

Therefore it is our duty to understand this to be one of the most important tasks in our future work and to undertake it with complete seriousness and understanding. We shall in every way be aided by all corresponding factors and our community entirely in these endeavors.

Conclusions

Here it would be possible for us to give only some of the general and initial conclusions regarding the material covered:

1. A future ABC war could possibly be a catastrophe if the entire population, and the medical service in particular, is not organized and professionally and psychologically prepared to defend the country.

2. To defend the country successfully and for the medical service to function well, there must be a large and qualified medical cadre. In addition, it is necessary also to prepare every citizen to do his share in caring for the mass of casualties which will result from an eventual ABC war.

3. A contemporary war would cause more wounded than all previous wars. This creates many problems, among which the prominent are: the problem of the cadre, the problem of materials, and the problem of time.

4. A responsible organization is necessary for successfully caring for the masses of wounded. It would have the task of securing care for the greatest number of wounded. The organizational care results in: immediate and well executed classification; quickly rendering medical aid on the spot; and evacuation of the wounded to an area where they can receive the greatest amount of medical aid.

5. The shortage of materials must be compensated for by rational expenditure, reuse of used material, use of local sources, and the maximum use of various improvisions. In this respect we can use the valuable experience gained in the NOB, which was truly conducted under situations of the utmost scarcity.

6. The systematic and planned training of the middle medical cadre is the task assigned in the first plan to all specialized associations, organizations of the public medical service, mass organizations, the press, and other forums.

7. The role of the middle medical cadre in contemporary warfare is important and large. Its activity covers many fields and the responsibility is large.

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POSITION AND ROLE OF THE MIDDLE-LEVEL AND LOWER MEDICAL CADRES IN THE PREVENTIVE SERVICE UNDER CONDITIONS OF CONTEMPORARY WARFARE

/Following is the translation of an article by Medical Captain Aleksandar Palic in Sanitetski Tehnicar, No 5, Belgrade, Sept-Oct, 1960, pages 438-445./

The following factors characterize the effects of contemporary warfare: extensive destruction, collapse of the living standards of the population, a decrease in resistence due to psychological and physical shock, spontaneous and organized migration from the area imperiled by the war, and the existence of a time of crisis.

All of the mentioned factors result in an abrupt intensification of the hygienic-epidemic situation. Such a situation intensifies a shortage of a sufficiently large specialized cadre, the unsatisfactory amount of the necessary materials and also the existence of endemic focuses of infectious diseases - a potential danger for the breakout of epidemics of great proportion among the population and armed forces.

In addition to the above-mentioned characteristics which intensify the hygienic epidemic situation under conditions of contemporary warfare, there exists the potential possibility of the disemination of biological agents as an effective weapon, which will intensify even more this difficult position.

Such conditions, under which the work of the preventative service will develop, demand from each member of the medical service, regardless of his professional background, that he find his place and engage in preparation for extensive preventive measures and their execution to the maximum with the aim of preserving the health of the nation and its fighting capabilities.

Before considering the place and role assigned to our cadre, we must first become acquainted with the basic problems of the preventive service, making our role clearer to us. In addition, we must also recognize it as a problem whose solution is of the greatest importance for national defense. The solution to this problem is still to be found in peacetime through the adjustment of everyday work and the specialized training under conditions similar to field conditions involving the use of contemporary weapons.

On the basis of this we will treat the most important problems of the preventive service, which are the following: the problem of suppressing contagious diseases, the hygienic problems of contemporary warfare (accommodations, water, food, physical condition, industrial diseases, etc.), anti-biological protection, specific

prophylactics, and others.

1. The Problem of Suppressing Contagious Diseases

Bacillary Dysentary.

The conditions of the lowest hygienic and cultural standards in each of our regions, the open question concerning the supply of drinking water, and also the question of the correct disposal of fecal substances result in the existence and continuous appearance of endemic focuses of bacillary dysentary.

The existence of these focuses together with the low hygienic culture of a large part of the population and poor sanitary conditions (water substances, canals, lavatories) present a potential danger for the spreading of mass epidemics under war conditions. This intensified by the fact that there is an improper attitude towards this illness among a certain number of medical workers (especially in the community). This incorrect attitude is reflected in the neglect of the epidemical opinion "every profuse appearance of diarrhea must be treated as dysentary, until it is established that there is another etiology". Even though practice has long ago confirmed this opinion, there are still instances of an incorrect relation and treatment of this illness.

Bacillary dysentary is today considered to be the most important and the largest wartime contagious disease. In previous wars not even armies with the most qualified technical equipment were spared the appearance of an epidemic of this illness which strikes large numbers; this is confirmed by the statistical information on the movement of the ill during World War II and the Korean conflict.

Epidemic Typhus and Recrudescent Epidemic Typhus.

During peacetime these two diseases generally occur in sporadic instances from endemic loci. They are often found in small villages in out-of-the-way mountain areas. These are small isolated focuses which are generally maintained through contact with relatives (mutual visits). The existence of filth as a result of the way of life of the population and the social economic factors present the biological basis for the endemic focuses of these illnesses. When we speak of the endemic focuses of epidemic typhus in the separate regions of our country, we especially must emphasize the role and importance of Brill's disease (especially the forms of the classical typhus in the sense of late relapse).

The epidemical importance of this disease is the possibility that the patient may become the source of an epidemic of real typhus with all the classical clinical symptoms. The bad economic and hygienic conditions which war causes, especially today, can in the shortest time result in the spread of a mass epidemic from these relatively small endemic loci. The migration of the population due to the war operations and also the transportation of personnel, who are sent to the front as replacements, under the above-mentioned conditions, will spread an epidemic of these diseases along every direction of their movement. This fact is best illustrated by the

examples of the mass epidemics of these diseases among the military and citizens in the Serbian army during World War I and in the NOR during World War II.

Malaria.

In World War I maleria appeared in great numbers as a frequent combat diseases, but with localization of the epidemic in the endemic field. Well organized preventative services of specialized units during and after World War II (antimalaria companies and platoons), and also the successful use of insecticides together with the reclamation of terrain have made possible the elimination of this disease in wide areas.

The extermination of the endemic focuses did not completely solve the problem of malaria. There still exists today in many areas favorable conditions for the breeding of mosquitos (marshes, swamps, brickyards and others) and this is sufficient enough in these areas to be the source of infection, cause illnesses and grow into epidemics. All the conditions for this exist under war conditions with the migration of the population.

Infectious Hepatitis.

This has appeared in all wars as combat disease. An especially large number of cases appeared during World War II both among the civilians and in the armed forces. During the final operations of our armed forces, especially the push on the "Srem Front", it appeared as one of the larger epidemics. This disease has a rather great importance even in peacetime because the number of those afflicted surpasses the number of those suffering from typhoid. This illness is very significant because of its importance for the larger groups of people, its long duration, the very long convalescent period, considerable infectiousness and the difficult complications.

Typhoid and Paratyphoid Fevers.

There exist a rather large number of endemic loci among the communities. The loci are localized throughout the villages and towns which do not have adequate sanitary equipment.

In previous wars they presented a large problem but the situation was improved when the use of specific vaccines and the intensification of hygienic measures were introduced. During World War II typhus abdominalis no longer presented a problem, although there were larger epidemics, but only among the citizens of the ruined cities and settlements due to the sharp decline in the hygienic index. This generally occured as the result of the destruction of sanitary communal equipment.

Tetanus and Gas Gangrene.

Tetanus is an illness which primarily appears in areas of intensive agriculture. During World War II the number of patients suffering from tetanus and gas gangrene abruptly fell off due to the use of vaccines, specific serums, antibiotics and the correct treatment of the wound by contemporary methods of medicine. On the other hand, with civilian population who were not vaccinated against tetanus,

this number did not drop. During a contemporary war a sharp increase in the number of cases can be expected due to the fewer possibilities of rendering surgical aid in due time to the large number of wounded.

Tuberculosis.

Although it is not an acute infectious disease and does not cause epidemics under conditions of modern warfare, tuberculosis can become an alarming problem. The long duration of warfare, deficiencies in the diet and the decline in the physical condition, especially in cities will probably cause a sharp increase in the number of cases, particularly among children. However the condition of active immunization of an entire population through specific vaccines will also increase.

Other Contagious Diseases as Epidemic Problems:

a. Influenza is the most significant of all the repiratory illnesses. The epidemic which followed World War I was accompanied by a large number of human casualties, indicating the danger that this illness can present as a wartime disease.

b. Contact with natural loci, which occur due to the specific conditions of life during a war, will cause the appearances of epidemics of illnesses which occur rarely and sporadically in peacetime. These would be the following illnesses: tularaemia, hemorrhaging fever, Q fever, ornithosis, leptospirosis, and others.

c. Quarantine Illnesses. Under conditions of modern warfare there exist the possibilities for their spread by allied or enemy soldiers if they have come in contact with the endemic loci of these diseases.

2. The Most Important Hygienic Problems

Accommodations.

The massive destruction of living areas and also the desire to escape the effects of contemporary weapons will cause organized evacuations and spontaneous migrations of a large number of the population. This presents the question of how to accommodate these people in small areas, villages, and temporary camps outside the larger centers. Regardless of accommodations, carrying out the basic hygienic measures and the improvisation of sanitary equipment will present a problem.

Water Supply.

Although in all previous wars water supply was always an actual problem, it will be even more critical during a modern war. Surface water is already greatly contaminated due to the discharge of industrial wastes (phenol and others) and it shall become even more so as industry develops. Add to this the favorable conditions for ABC contamination during a war, it will be clear that surface water must be disregarded as a source. The condition of substances which are found in underground water are also alarming with regards to their hygienic technical characteristics. For this reason the

use of water from underground sources will be permissable only after chlorination and superchlorination.

Food.

Since food concerns physical development, health, resistence against disease and the psychological physical condition of the population, it receives a special significance with regards to the defense of the country, due to the influence on work and combat capabilities.

A scarcity of food is regular counterpart to war. The appearances of famine, vitamin deficiencies and deficiency illnesses primarily strike the civilian population and most frequently children. With reference to this there is still the problem of securing the basic dietary needs for the population in peacetime and also the correct distribution of the reserve by plan according to the diet standard of the different categories of the population.

Physical Conditioning.

Exposure of the population to the large psychological and physical burden resulting from modern warfare demands a corresponding degree of physical conditioning also demanding the use of effective resistence to the enemy. The solution to this problem must be solved in peacetime through various forms of physical education of the youth and the laborers within the population.

Industrial Diseases and Industrial Trauma.

Even under normal conditions the sudden development of industry is accompanied by the appearance of traumas and also new industrial diseases which again strike the most active segment of the population. The increased number of patients with a great deal of damage to their health and also invalids are the result of the unsatisfactory conduct of hygienic technical measures in industrial safety. It is not necessary to emphasize how much damage this causes to the economic development and defensive force of the country.

This problem is even more sharply felt under war conditions with the inclusion of a large number of women, invalids, old and young and even people who due to their physical make-up are already sensitive to various harmful agents and do not have adequate experience.

Disinfection.

This will primarily concern drinking water according to the principle "that all water must be chlorinated regardless of its source" due to the possibilities of biological contamination. In addition there is the problem of regular disinfection of sanitary equipment, rubbish pits, living and storage areas, transportation vehicles and also disinfection in conjunction with other measures for the prevention of the results of a biological attack.

Insecticides.

They will be used, as the basic means of suppressing contageous diseases, against insects which the enemy might use as carriers of biological agents.

Vermin killers.

They will be used as protection for food warehouses and as a means of suppressing a biological attack. They will be used to destroy rats in the fields and in the settlements.

3. The Problem of Antibiological Protection

The misuse of pathological micro-organisms and their products for the artificial dissemination of epidemics as a weapon in the sense of a biological war presents the medical service with a whole series of new problems. Although biological agents have not been used before now in warfare, except in isolated and rare instances, a biological war is considered today to be a real possibility. Except for certain negative aspects for the aggressor (difficulties of weather and area limit an attack), the cheap production of biological agents in large quantities and in general the technical know-how for the use of biological agents makes them very accessible. Time and again one hears that biological agents were used during the Korean conflict, but this has not been proven.

In addition to the direct influence on men, his physical health and morale, a biological war also strikes usable plants and animal life with the aim of destroying them.

4. Specific Prophylactics

Large scale vaccination with specific vaccine produced in peacetime has a large significance in the defense of the country. Vaccination against childhood contagious diseases has greatly reduced the number of sicknesses, deaths and invalids among children and this again is positively reflected in the defensive potential of the country. It is especially necessary to emphasize the broad significance of vaccination against tuberculosis, tetanus and the salmonella group. The vaccination of the entire population against smallpox is important due to the possibility of its spread even in peacetime by means of international traffic. It is necessary to emphasize the importance of documentation when giving a vaccination against tetanus (registration on an identification card) for peacetime and war needs.

5. The Extent of the Preventive Work of the Medical Service; the Equipment and Material

The frequent changes in tactical situations, massive destruction, the loss of a clear boundry between the front and the rear area and also the shortage of forces and materials are the basic characteristics of a contemporary war.

The changed characteristics narrow the extent of the peacetime work of the medical service, but on the other hand they create a whole series of new problems, of which we have already spoken.

All this demands the determination of a minimum in the amount of preventative work and a minimum of materials which will make it possible to carry out all the basic hygienic prophylactic and anti-epidemic measures for the battle against wartime diseases and warding off a biological attack.

Regarding the equipment and other materials, it is necessary to take the stand that it is better to secure the basic equipment and materials in sufficient quantity than to procure expensive and rarely used equipment in insufficient quantities which are not suitable for work in the field under battle conditions.

The solution to these problems primarily demands the co-ordination of the military sanitation and the civilian medical services based on the identical comprehension of the principle of a united wartime epidemical program.

Included in the mentioned extent of work would be the following:

A. Hygienic Prophylactic and Anti-Epidemic Measures

1) The extent of the work: sanitation work, decontamination of food and water, the use of insecticides and prophylactic vermin killers against epidemic indications; then the control and preparation of drinking water, control of life provisions and food. Specific vaccination is one of the most important phases in the complex of preventative and anti-epidemic measures.

2) Materials: vaccines, serums, antibiotics, insecticides, material for disinfection, material for killing vermin and the technical means for sanitary work (dusting, bathing).

B. Work in the Laboratories.

This work plays an important role in prevention. Modern warfare conditions present this work with a series of problems due to the relatively complex diagnostic procedure, necessary special equipment and the mobile conditions of work which apply to all laboratories.

1. Microbiological Laboratories:

a) Extent of work: laboratory analysis of all important epidemic infections and also infectious diseases can enter into consideration for a biological war. The extent of the work is dependent upon the cadre and materials.

b) Materials: in addition to the basic laboratory equipment which must be adjusted to the field conditions of continuous mobility, special significance is given to dry preparations, diagnostic serums and antigens. Special attention is given to the necessary modifications of the already existing mobile bacteriological laboratories which will play their own role in the hygienic epidemic investigations in the field.

2. Chemical Laboratories:

a) Extent of work: judgment on the useability of drinking water and microbe content; discovery and identification of: toxic materials, conventional and nerve gases, new war gases, cyanide, heavy metals, materials for killing vermin and insects. Their area of

work includes the detection and identification of radiological contamination of water and life provisions.

b) Materials: in addition to the basic laboratory equipment, the introduction of mobile chemical laboratories and new field units equipped with all the modern means for detection are important.

6. Cadres

Although short, this outline of the preventative problems has indicated all the difficulties and diversity under conditions of a modern ABC war.

The shortage of qualified preventative cadres will primarily be felt. Therefore the solution of this problem must be approached initially from the broadest foundation. First of all, the active participation of the entire population in carrying out health protection measures must be provided. Then the entire medical cadre regardless of professional status must be activated; in addition to them all the professional groups in the related services must be recruited.

The activation of the above-mentioned personnel is to be carried out by means of training, despecialization and qualification in certain degrees according to the future roles and tasks.

CONCLUSIONS

On the basis of the outline presented on the problems which will confront the preventative services in a future ABC war, it is possible to work out the role and tasks that stand before the central medical workers.

The future plan for specialized training and qualification for solving the individual problems important for national defense must be developed according to the established plan for a minimum wartime standard.

The extent of this report does not permit a detailed treatment of so important a question as the concrete plan of training for our cadre. The aim of the report is to render only the basic orientation - something to act as the basis for the plan of the Society or their sections to work out in detail.

An analysis of the preventative problems would crystalize in the following:

1. The insufficient number of highly qualified cadres for the preventative service demands the qualification and maximum use of the middle and lower medical cadres for these jobs.

2. It is necessary to determine the minimum of necessary knowledge for active participation in solving the problems - the task that stands before us.

3. Our training of the middle medical and lower medical personnel must be orientated for qualification in practical work according to the following:

a. water treatment under field conditions,

b. mastery of the methods of disinfection and killing insects and vermin,

c. qualification for carrying out and using various improvisations in sanitary equipment,

d. the practical execution of detection and decontamination of foreign matter in water and food,

e. qualified hygienic epidemic investigation in the field with the corresponding equipment,

f. practical execution of all types of specific vaccination and,

g. technical work in the suppression of epidemics on the principles of isolation of the area.

4. Unavoidable is the use of the middle medical cadres for work in local medical field institutions in the following areas:

a. control and the liquidation of epidemic infections,

b. carrying out mass inoculation of the population,

c. raising the hygienic awareness of the citizens by health education,

d. the improvement of sanitary equipment in the field, primarily water sources,

e. the destruction of vermin as a potential danger of biological warfare and

f. participation in the destruction of dangerous insects as carriers of a number of infectious diseases.

5. The use of the middle medical cadres in conjunction with the sanitation organs is of the greatest importance because this presents good conditions for acquiring experience for work in the collectives under unfavorable field accommodation conditions.

6. They must be used also in devising simple methods of laboratory techniques for the diagnosis of the most important infectious diseases, the modification and adaption of the existing standard equipment and units for more effective work under field battle conditions in continuous mobility.

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TRAINING THE MIDDLE-LEVEL MEDICAL CADRES FOR EXTENDING AID IN MODERN ABC WAR

/Following is the translation of an article by Military Employee 5th Class, Zoran Lazarevic in Sanitetski Tehnicar, No 5, Belgrade, Sept-Oct, 1960, pages 458-466./

"...The use of atomic weapons in an eventual future war is taken to be a fact and there is no doubt the use of biological and chemical weapons will accompany them... The acquaintance of the medical cadre with the minimum war-time medical standard, i.e. the practical qualification of every category of medical worker for those medical jobs or medical work corresponding to the war-time medical program and the concept of the war organization in the medical service, is included in the realm of practical activity of every category of medical personnel"...

Preface of the book, Zdravstveni radnik u obrani zemlje.

One of the leading areas of work in the medical services during a war belongs to the middle medical cadre. Because of this, the adequate preparation for carrying out the wartime minimum medical standards for all types of middle medical cadre demands serious consideration and studious work for elaborating the program which must be systematically set up. Specialized associations, societies and sections have a very serious task before them which can successfully be carried out only with the combined efforts of all types of medical workers.

An eventual ABC war presents to the medical service, and accordingly to the middle medical service, a series of problems which did not exist with the use of conventional weapons in previous wars. A new series of tasks also results from this fact.

What are the basic tasks assigned to the middle medical cadre in carrying out the wartime minimum medical standards?

1. The study of the organization of the medical service in war.

2. The execution of a program which will make it possible for the middle medical cadre to render medical aid to the wounded and ill of a higher degree than they rendered in previous wars and during peacetime.

3. The training of the lower sanitation personnel and nurses in rendering aid also of a higher degree.

4. The training of non-sanitation personnel of the battle group in rendering self and mutual aid.

5. The training of the civilian population in rendering first aid.

6. The training of the middle medical cadre in the operation of detection and dosage equipment in the event of the use of atomic weapons.

7. The training in the decontamination of people, battle gear, equipment, food, water, medicine etc.

8. The training for work in the event of the use of biological and chemical weapons.

In presenting these tasks, we are governed by the fact that the middle medical cadre must render elementary medical aid. This type of aid is given to the second, third and fourth category of wounded which comprise about 60% of all wounded. In addition, there will be occasions when the middle medical cadre will give first aid. This will increase the percentage of wounded who will receive aid from the SMK (Srednjomedicinski Kadar - Middle Medical Cadre).

The mentioned tasks for carrying out the war minimum are not the only ones. In further elaboration there will appear a series of other tasks, but for the initial work in the execution of this program they can serve as an orientation for a future concrete plan.

1. The Organization of the Medical Service During War.

The function of the medical service will be completely changed and different from what it is in peacetime. The arrangement of the medical institutions, their organization, the tasks of the individual institutions at certain levels and in certain territories, the arrangement of the cadre and materials -- all this will undergo a radical change. During a war there is never sufficient personnel and materials, maneuvering them will be one of the most important tasks in making the maximum use of the existing capacities.

The formation of the medical institutions will be executed by teams who when needed will work together or alone. An ability for rapid maneuvering, adaption to work under unfavorable conditions, the sense and ability for improvisation, an understanding of the military and medical situation and many other problems which appear in an eventual modern war, cannot be solved without organization and solid preparation during peacetime.

In the past the educational programs of our schools for the middle medical cadres the organization of the medical service in peacetime has been taught, while the organization of the medical service in war was taught only in the middle schools of the army. Because of this there appears the need for all middle medical cadres to be acquainted for the first time with at least the principles of organization of this service during a war. Later completion of the knowledge must be considered as a continuous task, and all middle medical cadres must be in an adequately and continuously informed

and trained in all new techniques.

For the time being one part of the middle cadres of the army can serve as the nucleus of lecturers, at least initially, for limited questions, while for a certain part of the subject matter concerning new concepts, doctors and other cadre will be engaged. But our specialized organization must have an adequate and exact insight into the development of this education and in the method of its organization and also must be concerned with its execution in all branches. It is understood that our federal and republic directors must elaborate on the plan, secure qualified lecturers, discover a means for getting the necessary literature and in other ways assure the execution of these measures in the nation and especially in the smaller areas.

Without including a program on the organization of the medical services in war, it will not be possible for any middle medical worker to execute his task in the event of war, nor will he be able to fulfill his role in the defense of the country as might be expected of him.

The most important questions in this field on which instruction should begin immediately would be:

the task and importance of the medical service in war,
the specific war conditions of the work of the medical service,
the military medical program,
the basic measures of medical security during a war,
sanitation measures,
the system of treatment,
evaluation and means of evaluation,
the medical unit and its structure,
the basic characteristics of the work of the medical service under conditions of ABC warfare,
the basis of sanitation supplying,
chemical research.

2. Rendering of More Specialized Aid.

This question demands special attention in considering the role and place of the middle medical cadre. The very important and responsible tasks placed before us by this question demands the most careful preparation and conscientious supervision in its execution. They create another key task in the qualification of our cadre. This task has not come as the result of cabinet theorizing but has been forced by the development of combat technique, dynamics and the conditions of waging a modern war.

We do not consider it necessary here to enumerate all those concrete tasks which result from this question, but we can emphasize that all those which the middle medical cadre had earlier, considering in a broader sense the demand for complete training so that they may be responsible for the new tasks and qualified to render aid to some

of the wounded who previously were tended by doctors. Naturally a large part of the work regarding the degree of specialization in rendering aid, although it will remain the same, will demand work under new conditions; this also means that it will not be as it was in previous wars.

The characteristics of an eventual war are the use of nuclear weapons. The targets of atomic bombs will most probably be defense centers, concentrations of personnel and engineering, the larger cities, industrial complexes, traffic centers and general densely populated areas which will without fail cause a large number of wounded in a very short time. Two other characteristics implied are the large number of burns and radioactive contamination.

Caring for the mass of wounded on the front or in the rear area will add to the load of the middle medical cadre in the broadest sense. The organization of the treatment, collecting and accommodating the wounded, bandaging techniques, how to stop bleeding, classification, transportation immobilization, first aid for the more serious burns, care of the wounded until surgical aid is given and after it, these and many other practical jobs concerning the wounded will belong to the middle medical worker. All of this is exclusively independent work or only temporarily under the control of a doctor. It is understood that our schools, at least up to now, have not prepared the middle cadre for such tasks; only the middle school in the army has done this. Training the entire middle medical cadre for executing these tasks is absolutely necessary.

Only the middle medical cadre has not had the opportunity in peacetime to encounter something approximating conditions that might occur in the event of an atomic war (an example: a huge number of wounded in a very short time). To correctly treat a mass of wounded, the middle medical cadre must primarily be trained in the tasks we have spoken about.

In rendering aid it is absolutely necessary to have a good knowledge of the techniques in applying bandages of all types including bandages for burns.

In addition, the technique of stopping the flow of blood is one of the tasks where the lives of many wounded will depend upon the knowledge, skill and speed with which it is carried out.

The organization of the collection and accommodation of the wounded from the area where the wound occurred to an area for rendering the necessary aid occupies a key place in the correct and prompt treatment. Without training in this type of work, maximum rescue of the wounded is not possible. This is particularly important if it concerns radioactively contaminated ground, where the wounded will be harmfully affected if they remain for long; this lessens the possibility of complete recovery.

Considering the degree of speed, evacuation is not possible without a good and correct knowledge of classification. Knowledge of the categories of wounded is necessary to determine the required speed for evacuating the wounded. The many lives also depend upon

correctly organized classification. Without correctly organized classification there cannot be either good evacuation or good treatment. At the initial stage, the organization of the classification will be the task of the middle medical cadre and in some places also the lower cadre, but in the later stages for understandable reasons this task will be performed by doctors.

The organization and the conditions of classification will be influenced by a series of factors: the number of wounded, the types of wounds, the military situation, the arrangement of the cadre and supplies, etc.; they cannot be considered as equal in all occasions and conditions. Therefore this question must be studied in detail, taking into consideration all of the variables.

Correctly executed classification and evacuation is still not always a guarantee of success if correct immobilization for transportation is not also carried out. In many instances the wounded can not be left in the area where they received the wound, but must be evacuated to a higher treatment area due to the necessity of surgical aid. Correctly executed transportation immobilization will often be the deciding factor in the life of the wounded.

It is hardly necessary to emphasize that the standard means for immobilization will hardly be sufficient. A sense for improvisation and the use of materials at hand must be developed because only these materials will be plentiful and sometimes even they will be scarce.

The care of the wounded before and directly after they receive surgical care, especially the seriously wounded, is also one of the tasks of the middle medical cadre, who must be certain that the wounded are prepared when the time comes for their operation, and the post-operative care which is necessary to insure the success of the operation.

Much of the practical work in this field will require that some jobs previously performed by a doctor will become part of the assignment of the middle medical cadre. We do not need nor have the possibility here to enumerate all the practical jobs. That must be done in a concretely developed program. What must be emphasized is that this task is not a small one and the majority of jobs in the middle medical cadre have not received this training in the regular course.

If we would briefly examine the major questions, we would be able to cite some of the tasks which could possibly serve as the beginning of the work for carrying out this part of the program.

classification,
techniques for the use of all types of bandages,
stopping the flow of blood,
transportation immobilization,
combating shock,
knowledge of the indications of gas poisoning and the rendering of first aid,
procedures with contaminated wounded,

determination of the blood type,
giving blood and substitutes,
knowledge of acute radioactive poisoning and the measures for protection,
inoculation and a series of other tasks which the profile studies dependent upon the broadening and fulfillment of the program.

3. Training the Nurses.

The lower medical personnel, the nurses, whose task it has been to only give first aid and some work in the care of the wounded and ill, while being responsible under these conditions for a much broader field of work. In addition to rendering first aid and then only to the most seriously wounded, they will take over some of the jobs that were previously performed by the middle medical cadre. Some of the jobs will become completely theirs while others will be executed under the control of a doctor or middle cadre worker.

Their training and practical qualification for executing these jobs will certainly be one of our tasks. These tasks would be met in training which would include: work in an imperilled area, the care of wounded before and after they receive surgical aid, some tasks involving the maintenanceof hygiene, the care of the ill and others.

Considering the expected large number of wounded which increases the extent of the nurses' work, the quality of their training cannot be neglected.

It is possible to emphasize only some of the tasks which would also be suggestions for the development of a concrete program.

Collecting and accommodating the wounded
Rendering first aid (bandages, immobilizing, stop bleeding)
Classification in the area,
Primary decontamination (war gases, radioactive decontamination)
Chlorination of water
Anti-biological protection
Sterilization of bandaging material
Care during transportation
Basic patient care of the wounded and the ill, and others.

4. Training of Non-Sanitation Personnel - Battle Group.

In peacetime the entire citizenry passing through military training must receive a basic knowledge on rendering self and mutual aid. In cases of a massive number of wounded it is not possible nor desirable for the medical personnel to give aid to each wounded man, at least not immediately. If it is taken into consideration that of the entire group of wounded it is thought that about 40% will be lightly wounded and will be able to give themselves first aid in the sense of self or mutual aid, then it is not only justified but

necessary that each person be trained for this. The benefit is twofold: first, first aid will be received in time - immediately and second, it will relieve the medical cadres who hardly will be in sufficient numbers at a large scale disaster and who will not be able to also give aid to the lightly wounded.

Every member of a battle group must be trained in the most basic tasks in the event of being wounded; for example:

techniques of initial bandaging;
how to stop bleeding;
immobilization by use of the means at hand;
protection from further wounds, etc.

5. Training the Population.

Modern warfare will bring about a novelty which, like all novelties caused by war, will not be pleasant. The civilian population, especially in the large cities, can expect an enemy attack even though they are located in the "far rear area". As a matter of fact a modern war will not have any rear areas according to the earlier classical school of thought. These attacks will often result in losses far greater than those that the army has on the front. This will necessitate the task of training the civilian population in two directions: first, undertaking safety measures in order to decrease the number of casualties, and secondly rendering self, mutual and first aid.

The program to train the population would have to include practical training without a great deal of theory. The training must give exercises in certain tasks which are absolutely necessary in giving self or mutual aid.

the program generally must include:
techniques of bandaging,
techniques of stopping blood,
techniques of immobilizing with the means at hand,
first aid for burns,
first aid for war gas poisoning,
principle of decontamination in the field,
anti-biological protection,
disinfection of water,
sterilization of sanitary equipment for rendering first aid.

6. Training Middle Medical Personnel for Work in Managing Detection and Dosage Equipment.

Detecting and determining dosages in the event of an atomic attack will be one of the jobs of the middle medical cadre and they will carry it out in almost all occasions when it proves necessary. Our experience in this field is quite narrow and completely unsatisfactory. Knowledge of the equipment and the principles of the

equipment is also at a minimum. In peacetime, at least until now, a very small number of people of our type, work with this equipment. If we keep in mind that the degree of radiation of the wounded and his classification into a category of urgency will be practically determined through the aid of this equipment, and that this may be the decisive factor for further handling of his case, then it is clear that this task must be handled with complete seriousness.

This area is known to us more theoretically than practically and therefore it is necessary to use every opportunity, even outside the program, to become better acquainted with it and especially with the various types of equipment such as the equipment for:

measuring the radioactivity of water,
measuring the radioactivity of food,
measuring the radioactivity of medicines,
measuring the radioactivity of wounds.

7. Decontamination.

This is one of the most difficult and complicated jobs and it is closely tied to detection. In addition, the very people who execute it are in continuous danger that they themselves might perish if they are not properly clothed and protected.

The procedures are very complex and the objects quite varied, ranging from people to the ground and everything caught unprotected on the ground during an attack with atomic, chemical or biological weapons.

Decontamination may be radioactive, chemical or biological, depending upon the weapons used, and each has its own specific material and demands specific procedures.

Elaboration of the program for training for this job presents one of the primary tasks of the entire medical cadre. It is necessary to establish a solid (at least basic at first) knowledge of these fields as for example:

Decontamination - the conception and the materials.
Primary and final decontamination.
Personal means for decontamination.
Decontamination of the ground, equipment etc.
Controlling contaminated ground etc.

8. Training the Middle Medical Cadre for Work in the Event of the Use of Biological and Chemical Weapons.

The possibility of the use of biological and chemical weapons presents our cadre with a special problem.

a) The use of biological weapons makes it necessary for the middle medical cadre to have at their disposal a knowledge of the methods of biological detection. This includes the knowledge of the series of laboratory operations which serve in determining a

biological attack; in addition it is necessary to know the methods and means for taking various biological material for examination and its treatment; further the carrying out of various hygienic measures; and finally improvising sanitary equipment.

Of all of our middle medical cadre only the sanitation and laboratory technicians have experience in this work, while the other jobs are not concerned with these questions. These two types of workers could be used so that the organization in this work could be carried out in a satisfactory manner.

b) With the use of chemical weapons our task is more difficult and the work is more complicated. Here there are no experienced middle cadres.

The existence of a very strong combat gas with instantaneous effect indicates the need for better recognition of the effects of all combat gases. Here it is necessary to undertake a series of measures for better recognition of the effects of the individual combat gases, the means for protection - personal and collective, the manner of rendering first aid, and the treatment and decontamination.

In addition to training the medical cadre, it is necessary to emphasize that all of this must be taught to the civilian population so that they may undertake safety measures and render self and mutual aid.

First of all it is necessary to assure training of all cadres in the following:

Knowledge of the main types of chemical weapons, their qualities and characteristics.

Manner of activity of the combat gases according to group.

Self, mutual and first aid.

Classification and manners of evacuation.

Means of individual and group protection.

Taking samples of poisoned water and food and sending them for laboratory testing.

General conceptions of toxicology.

The types of biological agents, their characteristics and measures for protection.

It was not the aim of this report to state the program for training the middle medical cadre but only to indicate some of the most important tasks and to add a short and not quite complete introduction to a consideration of the question of training. Therefore we consider that it might be necessary for the plenary session to establish one body, a commission, cooperating with the other specialized organizations, to work out a plan and program for training.

On compiling the program it is necessary to have in mind the following:

1. The development of a program which the middle medical cadre of all types would have to master.

2. The development of a program of the narrower specialties for the individual specialists who would be more acquainted with

material for the eventual execution of exactly determined tasks, and

3. What is to be considered as necessary, urgent training, and what can be later introduced into a broader program.

In developing the plan and program it would be possible to take into consideration that our professional organizations have a certain number of specialized middle cadre workers who can play an active part as lecturers and instructors in carrying out this program; thus we will not have to seek all the help from other specialized organizations. By all means a certain amount of aid from the doctors' societies is absolutely necessary, and we hope that they will gladly give it to us.

Furthermore it is necessary to assure the execution of the program in all branches by adequately organized measures.

Finally regarding the question of training for ABC warfare, it would be erroneous if we were to orient ourselves only by lectures and exercises. It is necessary, at least for us, to make use of the existing literature written about this problem. There are a great number of works and articles about this in our newspapers and other professional publications. This literature should be used far more from now on than it has been previously. It is particularly true that in the event of a war each of us will undertake various duties without considerating what we did in peacetime.

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